UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT)

FIRST CONSULTATION
ON THE BUILDING
MATERIALS INDUSTRY

Athens, Greece
25-30 March 1985

Distr.
LIMITED

ID/WG.434/1
8 January 1985

ORIGINAL: ENGLISH

SMALL-SCALE BUILDING MATERIALS PRODUCTION IN THE CONTEXT OF THE INFORMAL ECONOMY *

prepared by the

United Nations Centre for Human Settlements
(Habitat)

* This document has been reproduced without formal editing.

V.85-20341

CONTENTS

		Page
	PREFACE	vi
	SUMMARY	1
	INTRODUCTION	3
1.	THE CONTEXT OF SMALL-SCALE BUILDING MATERIALS UNITS IN THE INFORMAL SECTOR	6
	Definition and scope	6
	Examples of small-scale building materials production	7
	Characteristics of small-scale building materials production units	9
	The evolution of the product and the technology	9
	Inputs required for the small-scale production of building materials	10
	Markets for the products of small-scale materials units	11
	Scale, continuity and production modes	11
2.	CONTRIBUTIONS TO THE NATIONAL ECONOMY BY SMALL-SCALE BUILDING MATERIALS PRODUCTION UNITS	13
	Contributions to the construction sector	13
	Contributions to the lessening of import-dependence	13
	Contributions through economic multiplier-effects	14
	Contributions to employment generation and income redistribution	15
	Potential contributions to economic development	16
3.	CONSTRAINTS TO THE PRODUCTION OF INDIGENOUS BUILDING MATERIALS IN THE INFORMAL SECTOR	17
	Quality of products	17
	Lack of basic inputs	18
	Markets	20
	Technologies	21

Page

4. MEASURES TO INCREASE THE CAPACITY OF BUILDING MATERIALS PRODUCTION IN THE INFORMAL SECTOR 24

Supply of basic inputs 24

Support for research and technological development 25

Promoting standards and specifications and other regulatory measures for the improved quality of products 25

Promoting informal sector organizations 25

Appropriate shelter policies for the low-income population 26

APPENDIX. CHARACTERISTICS OF VARIOUS TYPES OF BUILDING MATERIALS PRODUCTION PROCESSES 27

NOTES 35

BIBLIOGRAPHY 38

TABLES

		Page
1.	Capital and foreign exchange cost of brickmaking	27
2.	Comparison of labour intensity, capital intensity and machinery and tools used per worker, etc. in building material production in Sri Lanka (1973 values)	29
3.	Labour, capital resources used and capacity utilization in selected material production units, Sri Lanka (1973 values)	30
4.	Production characteristics of different roofing materials in Sri Lanka, 1973	31
5.	Foreign exchange requirements in production of building materials, Sri Lanka, 1973	32
6.	Unit production costs of brickmaking	33

PREFACE

There is little doubt that significant achievementsare being made in various industrial sectors of the economies of developing countries. The leading role of the construction sector, if effectively incorporated in that process, can contribute substantially to attaining the 25 per cent target of industrial growth set by the Lima Declaration in 1976 within a reasonable time-period. Perhaps the most important contribution that the construction sector can make to industrial growth is through its consumption of intermediate inputs, notably, building materials. In some developing countries, the cement, steel and wood industries, for instance, have already made an impact on industrial growth. Therefore, the building materials sector should be accorded a high priority in national industrial development.

In spite of some encouraging trends, the building materials industry is still unable to meet the demands made on it, and it is yet to maximize its contributions to development. This is due to the fact that indigenous building materials, which can lead to self-sufficiency and import substitution, have not been adopted on a wide scale.

UNCHS (Habitat) recognizes the importance of the building materials industry, especially because of its linkages with other sectors of the economy, its ability to stimulate industrial growth, its potential to generate income-earning opportunities and its technological flexibility in terms of sensitivity to labour-capital substitution. In particular, within its field of competence and as the focal agency for the International Year of Shelter for the Homeless, UNCHS (Habitat) is concerned with measures which will not only increase the industrial output of the building materials sector, but, in addition, lead to a significant improvement in shelter and related facilities for the least advantaged in society.

It is against such a background that this report has been prepared as the UNCHS (Habitat) contribution to the First UNIDO Consultation on the Building Materials Industry, in its capacity as a co-sponsoring agency of the Consultation. The report concerns the small-scale production of building materials in the context of the informal economy with the underlying purpose of examining ways to increase contributions to the indigenous building materials industry. UNCHS (Habitat) wishes to acknowledge the valuable support rendered by Mrs. E.J. Wells and Mr. D. Miles in the preparation of this report.

SUMMARY

Building materials, as the single largest input in construction activities, represent at the same time the main bottleneck in the construction industry in many developing countries. The latter issue is due to the fact that the availability of basic building materials has often been dependent on imports, using up foreign exchange, while there is a vast yet undeveloped potential to produce adequate supplies of building materials from abundant indigenous resources. In terms of shelter and basic infrastructure for the rural and urban poor, building materials, at times, are thus both the only input and drawback to self-help and community participation approaches in construction.

So far, a large proportion of building materials used for the construction of shelter by thelower-income groups, which constitute approximately 70 per cent of the total population in developing countries, have been produced in small-scale units, both in the rural and urban settlements, often using indigenous resources. In character, building materials produced in this manner, are largely informal when related to conventional processes. However, in spite of the informality, they have made a meaningful contribution to national economic development in several ways. Apart from the fact that a bulk of housing for the low-income population will remain dependent solely on this system of building materials output, there is evidence of high employment and skill generation, as well as useful economic multiplier effects through backward and forward linkages to other sectors of economy. Above all, there is a potential for further strengthening these contributions. First of all, there is the large unfulfilled demand for shelter by the low-income population which is now reaching an alarming stage and secondly, future contributions can be measured, for instance, through the possible substitution of the informal sector products with the demands of certain other categories of construction output, especially in view of the wide range of production scales within the informal sector and the frequent interactions with the formal sector.

The benefits notwithstanding, several factors have made it impossible to achieve adequate supply of building materials from the sector at reasonable costs and at acceptable quality, thereby limiting the wide-scale adoption of such materials even by the low-income population. These factors of constraint, especially those which are inherent to the informal sector, such as lack of basic inputs for production, low quality of products, and unfavourable factors of demand in terms of markets for the products, can be reduced if certain measures are implemented.

Much as the concept of informal sector building materials production may seem undefined to some extent, mainly because of variations in definition and importance from one country to the other (thereby making a standard set of measures inappropriate) the reality of the situation in several countries makes it necessary to attempt certain developmental measures. These are related to the availability of basic inputs, provision of regulatory procedures in the quality of products, application of research results and innovations in technology and the promotion of shelter construction programmes based on available local resources for the low-income population.

INTRODUCTION

Building materials are the main input to the construction industry which in turn is an important contributor to capital formation As economic growth is directly related to the level and efficiency of capital formation, it is therefore also linked directly to the capacity and productivity of the construction and building materials sectors, and the importance of promoting indigenous materials industries in the developing countries cannot be overemphasized. In recognition of this fact, the achievement by developing countries of self-sufficiency in building materials production has been adopted by UNIDO as part of the goal of generating 25 per cent of world manufacturing output from these countries by 2000 - the target set in the Lima Declaration and Plan of Action in 1975.

Progress towards this target since 1975 has, however, not been satisfactory. Although there have been some important gains in the production of building materials in developing countries, improvements have been concentrated in the prosperous countries of the group. Thus, while developing countries have improved their percentage of global production of building materials by substantial margins during the 1970s, imports of building materials are still predominant, with many African countries importing as much as 60 per cent of their requirements. 1/

The majority of developing countries have followed a policy of import substitution by way of industrial development strategy. Such a policy has also been applied in the building materials industries. This frequently means the establishment of local industries to produce materials identical to those previously imported - a process known as import reproduction. The local reproduction of previously imported building materials and components generally means that raw materials inputs used in the production process must continue to be imported (except where there are suitable local resources, although even when these exist, they are not always developed). This process usually also involves the importation of machinery and equipment which characteristically are capital intensive and require large quantities of imported fuel, spare parts and technical assistance for operation and servicing. Sometimes, only the finishing touches of the production process are carried out locally (such as the rolling and bending of bars from imported steel or the mixing of paint from imported chemicals). For instance, in the United Republic of Tanzania, it has been estimated that 57 per cent of the cost of locally produced cement is made up of imported components, while, in the local production of reinforcing steel, rails, asphalt, electrical goods and roofing sheets, all raw materials and components are imported. 2/ A similar situation prevails in Sri Lanka where between 50 and 100 per cent of raw materials for building materials are imported. 3/

Thus, local production of modern building materials in developing countries has generally amounted to little more than the substitution of one kind of imported material for another, using imported inputs and technology, with the minimum use of local labour and/or development of locally available raw materials. The consequent dependence on developed nations suppliers consumes scarce foreign exchange to the extent that there can be a collapse of the industry when these resources are no longer obtainable. In the United Republic of Tanzania, shortage of foreign exchange has led to restrictions on the importation of materials, components and equipment for the construction industry and raw materials and machinery for the building materials industry, resulting in run-down of production. "Consequently, the rate of inflation in the construction sector is now estimated to be in the order of 50 per cent per annum, with many projects now grinding to a halt - either through lack of essential inputs, or through lack of funds." 4/ A similar situation obtains in many other countries, particularly in certain small countries in Asia and Africa which are part of the group of Least Developed Countries. Building materials production plants which depend on imported inputs, using scarce foreign exchange, tend to operate at considerably less than optimal capacity and therefore affect the prices of products and in turn severely limit the prospects of market expansion. 5/

There is a need for wide-scale production and adoption in developing countries of low-cost building materials, using minimal amounts of capital and foreign exchange - that is, for the production of building materials for which the raw materials and other inputs are locally available. In several developing countries, a substantial amount of the building materials that are utilized for the production of basic shelter and related infrastructure in rural as well as urban areas, are produced by small-scale units, often using indigenous resources which are cheap and abundant. The production of building materials based on such small-scale units sometimes meets all the needs of small-scale private developers in rural trading centres and peri-urban areas, not only for shelter but also for structures which are used as workshops, commercial cooking areas, market stalls, kiosks, private clinics, restaurants, day nurseries etc. 6/ In some instances, small-scale production of lime and aggregates and the extraction of sand or laterite, for example, have contributed immensely to the construction of civil engineering projects. In so doing, these small-scale units satisfy a market which the large-scale modern sector activities and materials, because of their high cost, fail to do.

Characteristically, some of the small-scale building materials production units operate in rural and urban areas, often unregistered and with their activities not enumerated in governmental records. They are part of a complex network of activities which have been conveniently termed the 'informal sector'. There are several limitations facing small-scale building materials production units in the informal sector, but their demonstrated ability and potential contributions are more significant. In fact, it is the thesis of this report that if appropriate

measures are promoted, building materials produced by the sector, in addition to providing the basis for the bulk of low-cost shelter, could be used in non-residential and civil engineering construction in the formal sector, so that they could have a significant impact on the task of developing indigenous building materials, based on principles of self-sufficiency and import substitution.

Chapter 1

THE CONTEXT OF SMALL-SCALE BUILDING MATERIALS UNITS IN THE INFORMAL SECTOR

Definition and scope

Small-scale production units are frequently taken to mean plants with less than a specified number of employees (generally 30 in industrial censuses). The number of employees alone is however, not sufficient as a criterion since it could, for instance, lead to the inclusion of such diverse operations as a fully-automated quarry producing several hundred tons of aggregate per day. Other indicators, notably the volume of output and the size of investment in terms of capital and/or equipment, should therefore also be considered as criteria in a division of activities according to scale.

Small-scale building materials production units would, by definition, have few employees, little capital investment and a very limited volume of output, and are very likely to show other characteristics, such as production with locally available raw materials, production for strictly local markets (because of the small volume of output and high transport costs of heavy low-value building materials) and intermittent levels of production (because of flexibility in production owing to low investments and fluctuating markets). For these reasons, the term 'small-scale production' has become a synonym for labour-intensive, low-cost, intermediate technology or traditional production. It is not size that differentiates the levels of production units but rather the nature of the resources required and the capacity to obtain them. This is illustrated by the definition of small-scale industries given in an Act of Parliament by the United Republic of Tanzania which "defines a small industry as any manufacturing unit whose control is within the capability of our people, individually or collectively, in terms of capital and the required know-how". 7/

In the informal sector, small-scale building materials production can be defined by the same criteria as other economic activities in the sector. Thus, entrepreneurs can initiate investments with relative ease, production techniques are labour-intensive, enumeration, accountability and other bureaucratic procedures of governmental agencies are often ignored, levels of skills are low, and there is hardly an expectation of re-investment for business expansion. 8/ However, unlike some types of informal sector activities which can be classified as marginal to economic development, small-scale building materials production and other construction and manufacturing activities in the informal sector play a significant role in economic

development, as will be illustrated in the latter part of the report.

In fact, the distinction between the formal and informal sectors, when related to small-scale building materials production, is only arbitrary, since in both cases the same factors of production prevail. For instance, access to loans is a constraint for both (even though the informal sector has an advantage through traditional credit systems), basic inputs are often purchased from the same source in the formal sector, markets are limited owing to low volume of output, quality of output remains unspecified (since government regulatory mechanisms are usually ineffective in this field), backward and forward economic linkages with other sectors are strong, and there is general scope for expansion of production to fill marketing gaps. Therefore, the real situation is more accurately seen as a continuum of activities passing through several levels of informal production and merging into the formal sector.

If there is at the moment any precise distinction between small-scale building materials production in the informal sector vis-a-vis the formal sector, this is perhaps most accurately defined in terms of types of finished products. For example, glass, cement, nails, asphalt, plastics etc. are generally produced in the formal sector, while lime, pozzolana, bricks, tiles, concrete blocks, thatch roofing, stone and fibre-cement roofing tiles are commonly produced in the informal sector. The following examples may help to illustrate the nature of small-scale building materials in the informal sector.

Examples of small-scale building materials production

In the western part of the island of Java, Indonesia, locally occurring limestone is used for the semi-industrial production of lime in vertical brick kilns made from local materials, using firewood for fuel. Natural pozzolana from the area is extracted by hand, sieved and mixed with the lime (five parts of pozzolana to one of lime) to make blocks of lime pozzolana, known as batako. Small units making these blocks employ between 1 and 10 workers each, producing between 200 and 300 blocks per worker per day. The use of lime-pozzolana mixtures in Indonesia is traditional - dating back to the eighth century, at least, when a number of temples were built using lime-pozzolana mortar. Modern production emerged in the 1970s, following the initiatives of the Bandung Housing Research Centre (DPMB). This organization has undertaken a considerable amount of research to improve the quality of the product. It has defined the proportioning of lime, pozzolana and water, and the curing conditions for improved mechanical resistance of the blocks. It has also developed manual pressing-machines and mechanical vibration-moulds for the production of hollow blocks (an innovative material), and it has also developed programmes for the training of local craftsmen in these production techniques. Consequently, today both solid blocks, made by hand in simple moulds, and hollow blocks, made in semi-industrial units with manual pressing-machines or mechanical virbation-moulds, are produced by numerous small enterprises for sale on the open market. The former (solid blocks) are sold mainly

to small subcontractors and self-builders in the immediate locality. The latter (hollow blocks) are also sold in Jakarta and Bandung, and at prices 20 to 25 per cent lower than concrete blocks of the same size. [9]

In Colombia, there are many small-scale production units, located in a clay-soil area at the periphery of Bogota, known as Los Chircales, where clay products (bricks, clay pipes, tiles etc.) are manufactured. Landowners divide their property into lots of 300 to 600 square metres for rental to prospective investors. The investment required to commence production of bricks etc. is minimal, and most of the inputs required for production, notably a dwelling unit for the operator, a mill for mixing the clay, tools such as shovels, pick-axes and wheelbarrows, and the kiln which is usually constructed from bricks and fired by local timber - are obtained from locally available resources. One main item of investment is capital for the payment of wages for the labour force or, in cases where only family labour is used, money for subsistence until the products can be sold. Unskilled labour is the main input to the production process, and, with minimal investments in equipment, techniques are essentially manual and therefore contribute to low productivity. The manual techniques, small capacity of the kilns and low levels of skill lead to low volume of output and low quality of product, so that the market is predominantly for the self-build housing activities of the low-income inhabitants of the area. Nevertheless, bricks produced in this manner accounted for 11.7 per cent of the total production of bricks in Bogota in 1972. [10]

Building stone is produced in many parts of Kenya, particularly on the outskirts of Nairobi and near some small towns. Methods of production are 'primitive', [11] and the only sophisticated operation is blasting to loosen the rock (even this is not always necessary, as sometimes the rock is loose enough to be simply dug out by hand). This operation requires some technical knowledge, as well as purchased inputs, such as explosives and hand-drills, but many producers overcome this barrier by hiring the services of a blaster from the Nairobi City Council or the Prisons Department. The rest of the production process consists of the cutting and subsequent dressing of the stone into blocks of various sizes which are then sold in 30 cm. lengths. These processes are carried out entirely by manual labour with the aid of a few simple tools, and even the measuring is done without any equipment. The skills required are fairly simple - dressers can be trained on-the-job in a few months, and, although cutters take longer to train, far fewer of them are required. Thus, the level of technology in the production of building stone is low, capital investment is practically nil, and the only substantial input is unskilled and semi-skilled labour, the returns to which represent about 80 per cent of the total costs of production. It is therefore very easy to enter the industry and to expand production by opening new quarries. Quarry operators are usually not the owners but concession holders who may be very small-scale or part-time operators, relying mainly on family or seasonal labour. In a few cases, they might be substantial firms with more or less continuous operation and a permanent labour force of as many as 20 men. In general, wages are comparable with those of unskilled workers in other sectors of the economy and higher than those in agriculture.

There are several other examples in developing countries that may help to illuminate the enormous range and variety of small-scale production units that currently exist in the informal sector. In the Philippines, traditional building materials, often cottage industries, produce bamboo, bricks and roofing materials, and operate on a substantial scale. 12/ Again in Indonesia, small-scale building materials industries, (mostly unorganized labour-intensive cottage industry) run in traditional ways in the rural and urban areas, producing clay bricks, tiles, cement products, lime, bamboo, timber elements, stone, gravel, sand and pozzolana-lime blocks. 13/ In Sri Lanka, small-scale and traditional production units, producing bricks, country tiles, sand and lime, supply more than 35 per cent, by value, of total building materials used in the country. 14/ In China, 80 per cent of building materials, including bricks, tiles, fly ash, sand and stone, as well as 64 per cent of the cement used in the country are produced on a small-scale by brigade and commune enterprises. 15/

Characteristics of small-scale building materials production units

The preceding examples of small-scale materials production, drawn from different parts of the world, show the great variety of productive units that exist - both in terms of the product itself and the process of production. Although, at first sight, they may appear to have little in common, they have a number of important common characteristics.

The evolution of the product and the technology

A number of materials produced in small-scale units may be 'traditional' in the sense that they have been produced for generations in the same manner, with very little change in methods of production, inputs or technology. However, surprisingly few materials produced today are entirely traditional. Modifications to traditional products are sometimes brought about by the decreasing availability of certain key inputs, such as firewood for fuel in the firing of clay bricks or the decreasing availability of clay itself, as in certain areas of China. At the same time, there has been an increase in the availability of other 'modern' inputs, such as simple tools and equipment for the working and transport of raw materials. In many countries, a number of completely new industries have developed, entirely dependent on modern materials - either new or recycled. Innovations in the product or the technology employed in production might be developed by the producers themselves or pioneered by official research institutes and then disseminated. Although those in the latter category receive the greatest publicity, there is substantial evidence that product innovation is constantly occurring in small-scale manufacturing units in developing countries and that a surprisingly wide range of technology, tools and equipment now exists - even in Africa, commonly regarded as the least developed region in technological terms. 16/

As a result of this constant evolution of technology, there is no clear dividing line between traditional and modern materials but rather a range from purely 'traditional' with no modern inputs to 'improved traditional' to 'conventional' (such as concrete blocks) and, then, to 'innovative' or entirely new products. Likewise, the durability of the product also varies from 'temporary' materials requiring constant repairs (such as mud-blocks, adobe or unburnt bricks) to 'semi-permanent' materials (such as kiln-fired bricks)* to 'permanent' materials (such as concrete blocks and stone). Again, no clear-cut division exists, as even temporary materials may be given a degree of permanence by the addition in small quantities of other key materials and/or subjection to additional processes - such as the addition of small quantities of cement to soil or the impregnation of bamboo. Also, there is no necessary correlation between the stage of evolution and the durability of the product, as some of the most traditional industries (such as stone-dressing) still produce the most durable products. However, despite this great variety in both the products and the evolution of the production process, the technology employed in all small-scale building materials units is still, by definition, simple. There is very little investment in machinery or equipment (what there is is in tools rather than machines), and the majority of processes are carried out by hand.

Inputs required for the small-scale production of building materials

The basic inputs required for the production of building materials include labour (skilled and unskilled), machinery, equipment, tools, finance, energy, land or premises, and means of transportation. Although these inputs are the same for small-scale and large-scale formal industry production, the mix of inputs tends to vary between the two systems of production. In particular, there is a general tendency for small-scale production units to be synonymous with low investments in plant or machinery. For instance, there is evidence that capital investment per worker is small-scale enterprises producing bricks is only 1 per cent of that required for large-scale production. 17/ A comparison of capital requirements for roofing materials shows that, in Sri Lanka, capital invested in the production of country tiles was less than 0.6 per cent of that required for the large-scale industrial production of galvanized iron sheets. 18/

In the informal sector,small-scale building materials production units tend to consume a range of inputs similar to those previously described, but sometimes these inputs are very peculiar to the sector. For instance, the requirement for land or premises may be fulfilled by illegal processes of squatting or manufacturing in residential premises. In place of conventional financial institutions, there are traditional credit systems, such as money lenders and family donations, which respond to the needs of investors in the informal sector. Training of skilled labour is largely by the apprenticeship system, often, in modified form, involving on-the-job training. Sometimes, extensive use of family labour (including children and females) is adopted, so that this component of hidden costs is reflected in a reduction of final cost of building materials.

---

*As produced in the informal sector.

Where the production process involves the use of machinery and tools, there is often dependence on locally produced equipment and where imported machinery is installed, attempts are often made to provide innovative solutions to the problems of spare parts and maintenance, since there is usually little likelihood of obtaining imported spare parts. In fact, this level of inputs, for the informal sector, even applies to the transportation of raw materials and finished products. Here, the problem of lack of means of transportation, or high costs of transportation owing to scarcity of petroleum products, is minimized by the use of low-cost modes of transportation such as animal-driven carriers.

Markets for the products of small-scale materials units

The generally low level of skills required for the small-scale production of building materials as well as the low cost of labour and material inputs and, hence, the low level of capital required to start production mean that entry to the industry is relatively easy and certainly presents no insuperable barriers to the enterprising potential entrepreneur. Thus, the industry is highly competitive. It also means that costs, productivity, the quality of the product and the price charged for it are all relatively low (compared with the mass-produced products of modern industries), which could have an important effect on the market for the product.

There is evidence that the majority of products of small-scale building materials units, especially in the informal sector, serve the requirements of low-income populations in both rural and urban areas, who constitute the majority of households in developing countries. However, there are instances where products of this kind, such as concrete blocks or lime-pozzolana blocks, have been purchased by public sector construction agencies for governmental shelter and infrastructure development projects. In other instances, building materials and components produced in this manner have been purchased by high-income groups for shelter and non-residential construction, and this phenomenon is particularly significant when the formal sector production systems have collapsed so that the informal sector operates as the only source of production.

Scale, continuity and production modes

There are, in most countries, some relatively permanent small-scale producers of building materials with more or less continuous production, some degree of investment in fixed overheads (premises, equipment etc. and a relatively stable labour force. However, many more produce only intermittently, when they have orders and when their other activities permit. Some individuals might be permanent producers, in so far as they have been operating at the same place and producing the same product over a number of years, even though their production might be spasmodic or seasonal - as is the case with quarry-owners who integrate their quarrying activities with the agricultural cycle, so as to supplement their income as farmers. Others might regard the production of building materials as a purely temporary occupation - chosen because of the ease of entry - and might subsequently move on to other activities or back to previous occupations, as circumstances dictate or allow - such as new-comers to Bogota who might operate a chircal as a way of obtaining accommodation and, hence, an entry to the urban scene.

Thus, there is a wide variety of production modes in small-scale building materials activities - ranging from individual artisans, producing to order, perhaps with a number of apprentices, to self-employed individual producers or small family units, producing commodities for sale on a seasonal, temporary or permanent basis (known as 'petty-commodity producers') 19/ to small firms or capitalist enterprises with some accumulated capital, employing wage labourers on a more or less permanent basis.

Clearly, many of these units producing building materials on a small scale have come into being as a result of individuals actively searching out opportunities for the creation of employment or the generation of additional income to supplement inadequate existing earnings, as opposed to entrepreneurs with capital looking for profitable opportunities to invest. They fit well into a widely accepted definition of the informal sector 20/ as a productive, dynamic "intermediate sector, contributing to income and output, and capable of attracting and sustaining labour in its own right". 21/ However, such a definition is in contrast to another set of informal sector activities which have sometimes been termed the "irregular sector" or the "community of the poor". 22/

At the lowest level of informal sector production, entrepreneurs produce with high-priced inputs, supplied by modern manufacturing industry, but at the same time they are inclined to sell their products at low prices due to the highly competitive markets in which they operate. This tends to limit the possibilities for the expansion of demand for their products, leading to their being considerably constrained in their ability to accumulate capital for reinvestment and expansion, and, thus, in their ability to move on to a higher economic and technological plane. Also, their limited ownership of or access to capital means that they have very little 'economic muscle' to compete in the market place, so that they are highly dependent upon others - landlords, transporters and distributors. They are an 'exploited' as opposed to an 'exploiting' group within the national economy. 23/

As relatively permanent production units have succeeded, at least to some extent, in overcoming some of the constraints affecting other not so permanent units, they have made the transition from petty producers to capitalist enterprises. If the objective is to assist small unsophisticated units to emulate their successful rivals, (i.e.,to improve their technology and organization to reach a higher and more productive level than the prevailing one) in terms of producing in large quantities for an expanding market, any attempt to divide productive units into 'formal' and 'informal' sectors (or any other such division) and to confine discussion to one or the other of such subdivisions would clearly be counterproductive.

Chapter 2

CONTRIBUTIONS TO THE NATIONAL ECONOMY BY SMALL-SCALE BUILDING MATERIALS PRODUCTION UNITS

Contributions to the construction sector

In most developing countries, civil engineering works and non-residential buildings take a greater proportion of total construction output than shelter construction. Despite this disparity, residential construction is still a significant component of the construction sector, and it could be argued that, if official statistics were to account properly for the often - ignored residential activities in rural areas and urban low-income settlements, the ratio of residential output to civil engineering works and non-residential building would show an increase. Building materials and components which have been produced in the informal sector have contributed significantly to shelter construction in most developing countries, and the bulk of the population - usually the rural and urban low-income groups - has remained a captive market for the products of small-scale building materials units in the informal sector, so that a majority of houses built in rural areas and in the low-income settlements of urban areas are still dependent on this sector.

Although there are inputs apart from building materials required for construction output, residential construction amongst the rural and urban poor tends to have a higher proportion of building-material input than of other inputs. In fact, when residential construction is organized through self-build or community participation mechanisms, building materials and components are nearly the only inputs required. Far too often, shelter in rural areas and urban uncontrolled settlements has been seen as having only a social value, and any contributions to economic development have been marginally estimated in terms of value of inputs and value of fixed assets after construction. However, consideration should be given to the fact that, in rural areas and urban slums and squatter settlements, the house can operate as a factory after construction, providing shelter for commercial food preparation, repair and maintenance of vehicles and machinery, manufacture of tools, building materials etc., services such as laundries, and a host of other economic activities which are still meaningful even in the context of industrial development. To this extent, small-scale building materials units in the informal sector and, by implication, shelter for the rural and urban poor will continue to play a significant role in the construction industry of most developing countries.

Contributions to the lessening of import dependence

Faced with declining markets for their exports (both traditional and non-traditional) and burdened with the repayment of foreign debts, one country after another is being forced to pursue an austerity programme- in some instances, foreign exchange resources are not even sufficient to meet the basic food needs of the population, let alone provide for the requirements of industrialization and economic growth.

"If capital goods are produced domestically then there need be no foreign exchange restriction of this kind on the rate of growth of output ... with stagnant foreign exchange earnings, a strategy of industrial growth should be adopted which is biased towards the production of capital goods". 24/

It is in this context that the expansion of small-scale building materials production units must be considered, since they have demonstrated their contributions to the lessening of import dependence in at least two basic ways. First, the production and utilization of indigenous building materials and components, such as lime, pozzolana, soil-cement blocks, lime-pozzolana blocks, clay tiles and thatch roofing, have contributed to the reduction of demand for imported substitutes. Secondly, the informal sector has demonstrated its capacity to use a large proportion of inputs which are locally available, and, even where imported inputs are used, they can often be sustained without dependence on imported spare parts.

Contributions through economic multiplier-effects

Production of building materials in the informal sector provides additional benefits to national development in terms of backward and forward linkages in the economy. The consumption of building materials which are produced in this manner, not only for the shelter requirements of the rural and urban poor but to a small extent for formal sector residential, non-residential and civil engineering works, contributes to the economic performance of other sectors of the economy, notably agriculture, industry and transportation. In addition, the spin-off effects from expenditure on construction activities can be retained within the national economy, as opposed to the current 'leakage' which occurs through the use of substantial quantities of imported resource-inputs for construction projects. In the United Republic of Tanzania, it is estimated that the value of potential benefits, in terms of multiplier effects which are being currently lost, stands at 75 per cent of construction expenditure. 25/

Small-scale building materials production units in the informal sector consume a high proportion of intermediate inputs in the production process, generating backward linkages of significance to the national economy, as a large proportion of inputs is consumed from other economic activities in the informal sector - for example, the repair and maintenance of vehicles and machinery, the manufacturing of simple tools and equipment such as pick-axes and wheelbarrows, transportation of raw materials and finished products often by low-cost modes of transportation, and the purchase of raw materials such as sawn timber. Apart from creating links within the informal economy, building materials production in the informal sector depends to a large extent on inputs from the formal sector, notably of fuel consumed in the production process and chemicals, adhesives, tools and machinery.

What is more, a large proportion of local production of building materials takes place in rural areas. This has important implications not just from the viewpoint of equity but, even more importantly, for

the effect that it can have on the generation of employment and the expansion of commodity production in the countryside. This process can further the achievement of national integration and economic growth.

Contributions to employment generation and income redistribution

The nature of building materials production in the informal sector is such that it is largely a labour-intensive operation, with unskilled labour accounting for a substantial proportion of all the factors of production. In brickmaking, for example, the labour requirement for the production of 10 million bricks per annum ranges from 160 men in small-scale traditional units to only eight in a modern, highly automated factory. Hence, small units use 20 times as much labour as large units for the production of the same volume of output. 26/ Ganesan's comparisons of productin characteristics in different types of industries present a similar picture. In a comparison between different types of roofing materials, it was found that 960 workers were required for the production of country tiles as against only seven for an equivalent output (by value) of g.i. sheets. Thus, traditional small-scale units producing country tiles employ 137 times more workers than the least labour-intensive process for the production of roofing materials. 27/

The employment-generating potential of investment in small-scale building materials units can hardly be denied. Doubts may perhaps legitimately be raised about the quality of such employment, for frequently, employment generated with little capital investment is relatively 'unproductive' and thus yields low returns for long hours of labour. A number of recent studies of the informal sector have shown, however, that investment in those enterprises engaged in manufacturing, as opposed to trade and services, not only generates employment but also yields substantial output - in which case the employment generated cannot be said to be unproductive.

House, for example, has estimated that investment of K.Shs. 1 million* in the informal manufacturing sector in Nairobi would yield 5,500 jobs and K.Shs. 2,250,000 of output, compared with 500 jobs and only K.Shs. 744,000 of output from a similar investment in the formal sector. 28/ Such evidence adds weight to the findings of others that, although wages paid to employees in informal-sector enterprises show considerable variations, the returns to employees are frequently well above the levels of wages paid in the formal sector. 29/ This would appear also to be the case for enterprises in rural areas, where small-scale manufacturing firms in the 'intermediate sector' give better-than-average incomes for their owners, a higher rate of return on capital than in the 'formal sector' and wages comparable with those earned in the 'modern sector' and better than those in commercial agriculture. 30/

*U.S. $1 = Approx. 14.25 Kenya shillings, (1984 rate)

Unlike certain activities in the informal economy, such as trading, hawking and peddling, building materials production generates not only employment and income-earning opportunities but, equally important, skilled manpower which can easily be adapted to other sectors of the economy. Skill generation is achieved in two ways. First, skills are generated in the process of producing materials, such as clay bricks, tiles, timber components and iron-mongery, and, secondly, skills are obtained as a consequence of utilizing these building materials in the construction sector.

The effect of the creation of additional employment opportunities among unskilled and semi-skilled workers would be a redistribution of income nationally in favour of low-income wage-earners or poor sections of the community. This, in turn, would generate additional demand for the goods and services purchased by these groups - which are mosly, of course, the goods and services produced by the low-income earners themselves. Hence, the multiplier effects generated by the creation of additional employment would, to a very large extent, be retained within low-income communities, serving to reinforce their redistributive effects.

Potential contributions to economic development

There is considerable experience to show that a range of building materials produced in the informal sector can be reasonable substitutes for those produced in the formal sector, especially by large-scale production systems. A typical example is the replacement of Portland cement by lime, pozzolana and gypsum as binders. In road construction programmes, it is possible, for instance, to use lime in stabilizing soil, instead of cement. Formal sector residential and non-residential construction projects can benefit from the use of soil-cement or lime-pozzolana blocks and country clay tiles, following the examples of Indonesia and Sri Lanka. 31/ Most economies in the developing countries cannot sustain formal sector systems of production, so that there is a latent demand of informal sector products which could meet output requirements and contribute to the achievement of self-sufficiency and import substitution in building materials production. No doubt, when these potential benefits materialize, there will be a great contribution to economic development in terms of employment generation, skill generation, income redistribution and, in general, economic multiplier-effects which will stimulate growth in other sectors of the national economy.

Chapter 3

CONSTRAINTS TO THE PRODUCION OF INDIGENOUS BUILDING MATERIALS IN THE INFORMAL SECTOR

Quality of products

The quality of building materials produced in small-scale units is generally thought to be low and, hence, an obstacle to the expansion of their use. This is not necessarily the case. For example, bricks produced in traditional brick industries have been used in the construction of buildings that have stood, without repairs, for many years. 32/ Also, building stone, produced frequently in small-scale units, is a durable, high-quality and highly regarded building material throughout much of the world - a fact generally reflected in the high prices it is able to command in a number of countries. Nevertheless, materials produced by small-scale units are widely believed to be of low quality.

There might be a number of reasons for this. First, some materials produced on a small scale do have very short lives: these are generally non-durable or temporary materials, such as adobe, bamboo, wattle, thatch and mud-blocks. Structures built of such matter materials require constant repairs, and while this may not be a serious disadvantage for nomadic peoples or settled communities in the countryside where the materials are freely available, it clearly is a disadvantage in urban areas or for people in employment who do not have the time required for house repair. These materials, however, are used, because of their low cost, by the lowest-income-earning sections of the community, so that, in the short term, they have a very important role to play. 33/ Moreover, technical innovations have been developed that could extend the life of some of these products, perhaps by a substantial margin. Secondly, some other products of small-scale building materials units, although they might have a longer life than the purely temporary materials just mentioned, might be generally deficient in terms of strength or other physical properties (such as porosity or the degree to which they are susceptible to erosion) and, thus, frequently lacking in durability also. In the case of bricks, this could be a result of inadequate firing, that is,inadequate time and temperature in the kiln which means that the ceramic properties are not properly developed and that the bricks have performance characteristics closer to those of mud blocks. 34/ Similarly, lime produced in a traditional 'beehive' kiln might be of lower quality than the product of a modern kiln, 35/ and cement blocks moulded and compacted manually might have less strength than similar products made in vibrating machines. Perhaps, even more important than general low levels of quality is the fact that quality is frequently highly uneven. As testing facilities are seldom available to small production units (that is, there is no quality control), this can present problems in the construction process. It generally results in over-specification, in order to compensate for the possibility of uneven quality. Finally, building materials produced in small-scale units might be considered inferior in quality when they are made essentially by hand, so that they lack the even appearance and exact dimensions of their machine-made substitutes. This can result in additional work being required on the building site,

such as the final dressing of rough-cut stone or the rendering of brick or blockwork to obtain an acceptable finish.

There are two reasons why problems of low-quality production persist in the informal sector. The first is related to certain characteristics of the informal sector, such as the low levels of skills, ignorance of correct production procedures and fraudulence as exemplified in attempts to minimize the use of cement in concrete blocks at the expense of safety factors etc. The second, which is applicable to the formal sector as well, is that, for a majority of indigenous building materials produced in the informal sector, standards, specifications and testing procedures are yet to be formulated, documented and administered as part of government regulatory procedures. Building codes and regulations in most developing countries ignore the prevalent use of materials from the informal sector, thereby failing to provide any mechanisms for sustaining or improving the quality of products.

There is evidence that crippling restrictions have been lifted in a number of countries - for example, the removal of restrictions on the use of soil-cement blocks in Ghana. Although a great deal of time and effort is required to produce revised regulations and specifications based on appropriate standards and norms, it has been done in a number of countries, frequently with some international support. 36/ However, the problem then arises of ensuring that revised regulations are adopted and enforced. In this connection, it is useful to remember that building regulations and specifications are only guidelines- what is critical is how they are applied in practice. Since all important decisions affecting the use of materials in construction are taken at the design stage, application of indigenous building materials will depend to a very large extent on the training, background and attitudes of designers. Thus, changing regulations alone will achieve nothing, unless the current bias of designers towards modern, sophisticated, highly capital-intensive products and processes is also changed.

Lack of basic inputs

As already mentioned, the basic inputs required for the production of building materials are common to both the formal and informal sectors. However, it is the nature of constraints relative to these basic inputs, singly or collectively, that defines the peculiarity of the informal sector. In general, unskilled labour is in plentiful supply in the vast majority of developing countries and, therefore, presents no problem. The requirements for skilled labour obviously vary in accordance with the nature of the production process, but in the building materials industries as a whole, it is generally true to say that the skills needed are minimal and can be easily acquired through on-the-job learning. There is now considerable evidence pointing to the fact that the 'informal sector' of the economy and, in particular, the 'intermediate' sector of small-scale manufacturing enterprises serve as a significant training ground for industrial skills.37/ Sometimes, skilled manpower deficiencies

are discovered with the introduction of innovations in either products or production processes. In these cases, some technical inputs, from external sources, might be required, and these might take the form of the loan of key items of equipment or key personnel for the demonstration of and/or the provision of training in the new technique.

If the informal sector, enterprises are limited in their operational efficiency, owing to low levels of managerial skills. While this might not be a crucial factor for relatively simple activities, it certainly is vital for manufacturing and building contracting activities, since these are so much in interaction and competition with their formal sector alternates who clearly have opportunities for improving their management techniques. Related to building materials production in the informal sector, lack of managerial skills has contributed to many problems, such as lack of forward planning to offset shortages in basic raw materials, unfavourable procedures for marketing of products and general difficulties in penetrating formal-sector markets.

There appears to be fairly widespread agreement among those who have undertaken research in the informal sector that small-scale manufacturing enterprises are constrained in their ability to acquire a number of vital inputs, particularly key raw materials, energy and tools. This is particularly a result of the weak bargaining position of such enterprises in obtaining access to capital vis-a-vis the large scale firms which generally control the supply. Small firms frequently have to purchase vital inputs from large powerful organizations at prices largely determined by the latter. In the process, a certain amount of surplus is transferred from small to large enterprises, contributing to the 'exploitation' of the former by the latter and inhibiting the ability of the small enterprises to accumulate capital on any significant scale. 38/ Such a situation is less likely to arise in those industries which make a little use of scarce modern sector inputs, such as those producing bricks or quarrying stones. It should be noted that governments frequently reinforce this general inequality in access to resources, especially foreign resources, by favouring large firms, for no other reason than that they are vocal, visible and easy to deal with.

As previously mentioned, the majority of small enterprieses in developing countries have no access to formal sources of capital or credit but are forced to rely upon the savings and borrowings of family and friends. While, in many ways this provides a source of strength for the enterprises themselves (in so far as costs are kept down by the absence of heavy interest payments on loans) and for the economy as a whole (in that it forces the mobilization of domestic sources of capital), it also has many serious negative effects. Apart from leading to problems in the procurement of vital inputs, as discussed before, a shortage of capital means that producers are unable to finance the building up of stocks. As many of them can produce only in small quantitites and are unable to expand their output rapidly in response to sudden increase in demand, this has serious repercussions on the prospects for successful marketing and the expansion of production in the long term.

Thus, capital shortages force small producers to operate as sub-optimal levels of output and employment, and because of difficulties in procurement and marketing, there is an increase in the dependence of small enterprises on large-scale firms or, even, a tendency to force the subordination of the one to the other. 39/ For these reasons, the lack of access to capital must be regarded as the most serious constraint, in terms of inputs, to the expansion of the activities of small-scale manufacturing units.

Actions by governments which favour loans to the large-scale sector need not be deliberately discriminatory, since they might simply be a reflection of the genuinely higher risks involved in lending to small organizations with little or no collateral rather than to large ones. They might also reflect the higher administrative costs of handling a large number of small loans rather than a few large ones. Whatever the reasons, there is evidence from a number of sources that government credit schemes, whether designed for small business in general, for small rural industrial enterprises or for small firms operating in a particular sector of the economy, have generally not been very effective in meeting the needs of the small enterprises they were intended to serve. 40/

Markets

The main market for informal sector building materials is found among the low-income sections of the population who purchase these materials directly for the construction of their own houses or indirectly through the small-scale indigenous contracting industry. However, some significant percentage of certain materials, such as building stone, might find its way into the 'formal' contracting industry. It is a common assumption that the products of the small-scale manufacturing sector in general are regarded as inferior goods even by the low-income groups whose needs it serves so that prospects for market growth are limited. Therefore, an increase in the incomes of the low-income population, on its own, might not lead to an increase in demand for informal sector products, unless such products become competitive with large-scale products in terms of quality and variety. In fact, there is evidence that as their incomes rise, people tend to purchase goods from the large-scale manufacturing sector rather than the informal sector, and this is true even at very low levels of income. 41/

It is a fact that, at certain levels of income, many consumers prefer to build their houses with the products of large-scale, capital intensive industries - as is evidenced by the ubiquitous appeal of cement blocks, modern windows and galvanized iron (g.i) roofing sheets. A similar situation can be observed with non-residential buildings, whenever the availability of resources permits - as is the case when governments or large private sector organizations are the clients. With increases in incomes among the population as a whole, 'market constraints' or blockages to expansion might develop for the informal sector as a result of preference for transfers to large-scale, capital-intensive production outputs.

Modern mass-produced materials such as concrete and galvanized iron, not to mention steel, glass and plastics - are obviously durable, strong and generally efficient in the functions which they are designed to perform. Thus, they do keep out the rain, the cold or the sun very effectively and for many years without repairs, so that few other materials can challenge them in either effectiveness or 'cost-in-use'. Consequently, the choice of these products may be entirely rational from the consumer's point of view, as long as they continue to be available at prevailaing market prices.

Technologies

Some building materials cannot easily be improved without significant increases in costs. However, many materials can be improved with little or no increase in cost or, in some cases, with even with a cost reduction. Much research work has been carried out during the past 20 years, both in developed and developing countries, into the possibilities for improving production techniques of building materials used in the informal sector. Many such technological innovations have been designed to improve the durability or strength of the basic material, such as techniques for the impregnation of bamboo and the stabilization of soil by the addition of small quantities of various types of stabilizers or the development of an 'insulator' kiln to improve the reliability of the firing process for bricks. Other innovations have been designed to reduce the quantity of materials required in certain products and, hence, the cost, such as the introduction of new types of moulds for the production of hollow blocks, which should result in lower transport costs and faster speed of erection on-site owing to the lower weight obtained. Technologies have also been developed for the use of reclaimed or recycled materials such as the use of fly-ash, reclaimed concrete or ground broken bricks as aggregates in the mixing of concrete. Finally, new uses have been found for existing materials, resulting in new products suitable for production on a small scale using manual processes, e.g., the development of fibre-reinforced concrete for roofing sheets and tiles.

Very few of these developments, however, have progressed beyond the laboratory or the construction of one or two prototype or demonstration units. While it is commonly supposed that the barrier to the acceptance of innovations of any product by small-scale producers is simple conservatism and inertia, there is some evidence pointing to the fact that this is not necessarily the case. There may be sound reasons for the failure of small entrepreneurs to adopt new techniques and/or develop new products. One of these is that all the risks of producing a new product or adopting a new technique fall upon the producers, and, with few resources available to them, many simply cannot afford to make mistakes. Furthermore, they often lack the necessary capital and/or foreign exchange resources required for production, especially in view of the fact that new technologies often need high technology to produce tools and equipment.42/ Finally, they cannot be sure that the product, if it is a new material or component that is being produced, will be accepted by clients.

There are two other constraints, closely related to the above, that have created barriers to introducing and replicating technologies, especially with regard to the production of new indigenous building materials in the informal sector. First, attention to customer needs, especially since supplementary skills are required for the use of new materials, is particularly important. In the case of fibre-cement roofing components, it has been suggested that the market should initially be served under 'supply-and-fix' arrangements, so that the customer can be provided with a finished roof rather than a consignment of unfamiliar components which might be misused, leading to trouble.43/ It should be noted that fibre-cement technology has progressed since this was written, but the general injunction that the customers/users of new building materials need help, as well as the manufacturers, is worth bearing in mind. In Parry's words:

> "Once significant resources of know-how and skill in handling the products have been accumulated by local artisans in the building trade, then the general introduction of the products can begin without special restrictions".

The introduction of a new product based on a new technology inevitably gives rise to changes in other areas of the system of which it is a part, and a systems approach should be adopted by the sponsor/propagator of new technology, in order to ensure that it is fully understood and accepted by producers and clients/customers. Failure to understand this requirement might be a factor in the phenomenon of frequent experimentation but few fundamental advances in low-cost building materials production.

A second factor in the failure to carry technological innovations through to the stage of widespread replication is the lack of accepted product standards. The construction industry is highly conservative in its approach to new and modified building materials, partly because of the long life expected from the final products and partly because of the separation of responsibility for design from the responsibility for physical construction. Far from favouring small-scale manufacturers, construction standards and specifications frequently favour large-scale producers, owing to the difficulty and cost of obtaining approval for new or modified products. The costs of laboratory and field trials to secure acceptance by standards institutions and other regulatory bodies are formidable and could not be contemplated by individual small-scale producers. A further difficulty is the lack of simple and agreed methods of quality control and inspection to give a guarantee of adequate performance in use.

In the case of lime-pozzolana, the lack of accepted standards is a great constraint, and consideration has been given to limiting its use to the manufacture of concrete blocks, so as to minimize this problem and prevent the possibility of misuse as a Portland cement substitute. The case of improved small-scale brickmaking presents a contrasting problem, since the new product is distinctly superior to the traditional slop-moulded brick. Although its ex-works price is higher than that of the traditional brick, its

cost-in-use is lower, since external rendering is unnecessary and maintenance costs are minimal. If an appropriate product standard was available and adhered to by all operators of the improved technology, it would thereafter be possible to create a market based on the twin attractions of improved quality and low-cost. The fibre-cement roofing tile has already shown its worth in trials, but again it is not possible for individual small manufacturers to finance extended acceptance trials that would be a prerequisite to widespread specification by national clients, sucha as housing corporations.

While it is understandable and correct that standards institutions should be extremely cautious regarding the acceptance of new materials, particularly in structural applications, a degree of flexibility is essential to enable new and modified low-cost materials to find their way into the market-place without the excessive cost and time required for extensive field trials. A strong case may, therefore, be made for applying a less extensive and less expensive testing and approval procedure to low-cost, non-structural building materials and components than is demanded of items that are to be applied in multi-storey buildings or other structural uses. The introduction of a two-tier regulatory system need have no adverse effect on safety but would enable new materials to make an impact on the desperate need for affordable housing and other forms of shelter.

Chapter 4

MEASURES TO INCREASE THE CAPACITY OF BUILDING MATERIALS PRODUCTION IN THE INFORMAL SECTOR

It has been established in this report that small-scale units producing building materials in the informal sector of the economy are capable of satisfying the building materials requirements for the provision of shelter and basic infrastructure for the rural and urban poor. They could, therefore, also make a significant contribution to the development of the national economy, both indirectly through the creation of an indigenous low-cost construction capacity and directly through the effect of expanded production in employment and income generation, especially in the rural areas. However, these benefits have yet to be achieved, owing to the persistence of constraints which could be minimized if certain measures are adopted. The following measures should be of interest to international agencies in their support of national governments to find ways of developing building materials production in the informal sector, so as to increase its contribution to national self-sufficiency and import substitution.

National governments can promote an increase in building materials production in the informal sector by providing support in various ways.

Supply of basic inputs

The constraints faced by entrepreneurs in the informal sector of building materials production in obtaining basic inputs, such as land, finance, training, tools and transportation, can be minimized if governments focus on:

(i) Providing incentives to entrepreneurs by reducing import duties on basic machinery and extending tax concessionsto new entrepreneurs in "high-risk"building materials production units;

(ii) Minimizing the initial cost of land, premises and basic infrastrucutre, by renting serviced plots and premises to entrepreneurs for a reasonable remuneration;

(iii) Providing favourable fiscal policies to strengthen traditional and informal sector credit institutions, through direct investments in seed capital and adjustment of interest rates;

(iv) Providing managerial on-the-job training to selected groups for wide-spread replication in the sector;

(v) Ensuring flow of information and opportunities for participation in public sector-sponsored workshops, etc. in the field of technology application.

Support for research and technological development

Governments can improve productivity as well as close the gap between research findings and wide-scale adoption of such findings by:

(i) Undertaking demonstration projects jointly with established informal sector producers;

(ii) Disseminating information on improved production methods;

(iii) Providing on-the-job training on new findings related to production.

Promoting standards and specifications and other regulartory measures for the improved quality of products

The problem of low quality of informal sector products, which tend to limit their durability and wide-scale utilization, can be minimized through governments:

(i) Undertaking the formulation and documentation of appropriate standards and specifications for the production and utilization of indigenous building materials used in the informal sector, such as thatch roofing, bamboo, reeds, stone, adobe, stabilized soil, lime pozzolanas and gypsum;

(ii) Disseminating information and demonstrating methods of applying such standards and specifications in the production process;

(iii) Using competitions as incentives, to encourage the optimal use of improved materials and other resources.

Promoting informal sector organizations

Trends in the formation of organizations in the informal sector do exist, and governments can promote this development so as to provide an efficient mechanism for assisting the sector. At the same time, such action can form the basis for "self-help" development. In this regard, attention should focus on:

(i) Providing logistic and organizational support for the associations;

(ii) Channelling the supply of basic inputs to the sector through such organizations;

(iii) Organizing purchases of building materials from the informal sector for specific government projects or other forms of formal construction activity;

(iv) Utilizing informal sector products in specific government-sector construction projects.

Appropriate shelter policies for the low-income population

Governments can stimulate and sustain an increase in supply capacity indirectly by promoting shelter programmes which favour the requirements of the low-income population. Focus could be on:

(i) Implementing self-help and community participation shelter programmes, using resources available in the informal sector;

(ii) Establishing and strengthening housing finance strategies which assist low-income groups to acquire materials produced by the informal sector.

Appendix

CHARACTERISTICS OF VARIOUS TYPES OF BUILDING MATERIALS PRODUCTION PROCESSES

Capital requirements worker

There is evidence to show that small-scale informal units producing building materials require substantially less capital investment than industries producing on a large scale the same amount of output. An analysis of the capital requirements for the production of bricks using alternative technologies is shown in table 1.

Table 1. Capital and foreign exchange cost of brickmaking

Process	Total Capital cost/10m p.a. ('000 US.$)	Percentage of cost imported	Local
Small-scale traditional manual process	34	5	95
Small-scale intermediate technology	578	15	85
Mechanical plant with Hoffman kiln	3880	75	25

Source: J.P.M. Parry, "Technical Options in Brick and Tile Production", paper presented to Intermediate Technology Workshop, Birmingham, 1983

It is clear from table 1 that the capital required for a large mechanical plant with a Hoffman kiln is more than 100 times that required for a small-scale, traditional manual brick-making unit to produce 10 million bricks per annum.

Additional evidence of the capital requirements of traditional small-scale production, as opposed to large-scale building materials industries, is provided by Ganesan in his various studies of the industry in Sri Lanka.[1/] This is presented in tables 2, 3 and 4.

From table 3, it can be seen that the capital required per worker, * in traditional production units as a group, ranged from Rs. 400 - 2,000, which compares very favourably with a requirement of from Rs. 9,800 to 217,000 in modern industrial units (i.e., the large and modern units may require up to 500 times more capital). Disaggregating this information to the level of individual industries, table 3 shows that capital requirements per worker range from a low level of Rs.400 for the production of sand and cadjan, Rs.500 for country tiles and Rs. 700 for bricks, to high levels of Rs.93,000 for the production of steel. Even more interesting, table 4 shows a comparison of the production characteristics of different types of roofing materials, that is, materials which could potentially provide substitutes for each other. The capital required per worker ranges from Rs.500 for the production of traditional country tiles, to Rs.82,000 for the modern industrial production of g.i. sheets.

Additional support for these figures can be found in some of the literature now available on the informal sector. Thus, Bose, found that the capital invested per worker in the informal sector in Calcutta was only 16 per cent of that in large formal sector enterprises in the same city. Sethuraman, from a number of studies sponsored by ILO, noted that the capital required per worker in manufacturihg activities in the informal sector was everywhere much the same - between US $200 and $350.[2/]

Foreign exchange requirements

Small-scale building materials production units not only require less capital than large plants but also require considerable less foreign capital - both in terms of initial installation and operating expenses. This is demonstrated by the information presented in tables 1, 4 and 5. From table 1, it can be seen that the imported component of the capital costs of brickmaking in small manual units is only 5 per cent of the total capital cost, compared with an import-component of 75 per cent of the capital costs for a large-scale mechanical plant with a Hoffman kiln.

---

*US$1 = Approx. 9 Sri Lankan Rs. (1975 rate)

1/ Ganesan (1982).

2/ Sethuraman (1984).

Table 2: * Comparison of labour intensity, capital intensity and machinery and tools used per worker etc. in building materials production in Sri Lanka (1973 values)

Sector a/	No. of establishments	Average output per establishment Rs.	Employment (direct) in Rs. 1m production b/ No.of persons	Payment to labour (direct) in output b/ %	Gross capital assets per worker c/ m.v. Rs.	Machinery and tools per worker m.v. Rs.	Capital output ratio m.v. Rs.
Traditional	100	below 50,000	410 d/	36	400-2,000	1-700	0.3-0.8
Small-scale including traditional	169	below 300,000	130 d/	21	400-12,000	1-7700	0.3-1.9
Modern medium-scale	28	300,000 1,000,000	40	10	6,400-44,000	2,500-24,000	0.4-1.6
Modern industrial	12	above 1,000,000	37	17	9,800-2,17,000	3,300-1,82,000	0.2-4.3

m.v. - market value of assets.

a/ Principal materials in the different sectors are given below. Some materials are manufactured in more than one sector. Traditional: Bricks, country tiles, sand, lime, cadjan, etc. Small-scale: Timber, cement products, brassware, aggregate, drainage fittings, electrical fittings etc. Modern medium-scale: Flat tiles, paint, varnish and distemper, wire nails, electrical fittings and switches, brassware and other fitting, etc. Modern industrial: Cement, steel, plywood products asbestos cement products, hardware, ceramics, plastic pipes, electrical cables, etc.

b/ At ex-factory price.

c/ Working capital was not included.

d/ A part of this employment is part-time or seasonal. No allowance has been made for this in the computations in this table.

Source: Ganesan (1979), op. cit., p.25.

* Table 2 reproduced from Ganesan (1982).

Table 3: Labour, capital resources used and capacity utilization in selected materials production units, Sri Lanka (1973 values)

Building material	No. of establish-ments	Direct employ. in Rs. Im production no. of persons	Income generation (direct)(percen-tage)	Capital assets per worker (m.v.) Rs.	Machinery and tools per worker (m.v.) Rs.	Capacity utilization (percentage)
Traditional and small-scale units						
Bricks	37	1,120	47	700	10	67
Sand	13	850	79	400	13	44
Country tiles	4	850	47	500	6	63
Cadjan	5	800	52	400	1	44
Aggregate						
(a) Manual quarry	2	560	45	1,300	110	81
(b) Mech. crusher	6	110	21	8,400	4,000	14
Lime	17	240	28	1,600	40	50
Brassware	19	140	25	1,400	700	53
Drainage fittings	15	100	26	7,300	3,700	65
Modern medium-scale and large industrial units						
Flat tiles	5	140	21	6,400	2,500	65
Hardware	1	100	31	25,000	20,000	25
Cement	1	26	14	93,000	46,000	67
Asbestos cement	2	16	10	12,000	5,100	68
Steel	1	16	9	59,000	29,000	41
Paint, varnish, distemper, etc.	9	14	8	26,000	14,000	31

m.v. = market value
Source: Ganesan (1979), op. cit.

Table 4. Production characteristics of different roofing materials in Sri Lanka, 1973

Sector	Building material	No. of establishments	Total employ. in Rs. 1m production No. of persons	Capital assets per worker (m.v.) Rs.	Machinery and tools per worker (m.v.) Rs.	Capital output ratio (m.v.)	Foreign exchange content in output (percentage)	Capacity utilization (percentage)
Traditional	country tiles	4	960	500	6	0.5	0	63
Modern-medium-scale	flat tiles	5	220	6,400	2,500	0.9	10	65
Modern-industrial	flat tiles	1 (6 factories)	220	11,000	5,700	1.5	10	75
Modern-industrial	asbestos-cement products	2	23	12,000	5,100	0.2	41	68
Modern-industrial	G.I. sheets	1	7	82,000	n.a.	0.6	82	n.a.

m.v. = market value.
Source: Ganesan (1979), op. cit., p.30.

Table 5. Foreign exchange requirements in production of building materials, Sri Lanka, 1973

Building materials	Foreign exchange cost as percentage value of output at ex-factory price				Total foreign exchange cost Rs. m c/
	Raw materials	Energy a/	Maintenance (+depreciation) b/	Total	
Cement d/	6	13	6	24	20
Cement products	0	8	0	8	
Steel products	53	2	2	57 e/	32
Timber	0	2	1	3	3
Bricks	0	0	0	0	0
Tiles	0	8	2	10	2
Aggregate	6 f/	4	2	12	3
Sand	0	0	0	0	0
Earth, clay, etc.	0	0	0	0	0
Lime	0	0	0	0	0
Asbestos cement products	39	0	1	41	13
Special steel fixtures	-	-	-	100 g/	15
Paint, varnish, etc.	60	0	1	61	4
Hardware	32	4	2	38	12
Sanitary-ware	13	4	2	19	2
Sanitary pipes	37	2	4	43	4
Electrical fittings	47	1	4	51	12
Cadjan	0	0	0	0	0

a/ Mostly furnace oil and resources for generation of electricity locally.
b/ Assumed to be 3 per cent of replacement value of machinery and tools which is considered essential for purchase of spare parts and to meet at least part of depreciation cost of imported machinery.
c/ Adding foreign exchange required in other materials, transport, and plant and equipment, total requirement in 1973 for all construction was approximately Rs.200 M.; together with other requirements, final requirement of foreign exchange was about 10 per cent of gross foreign exchange earnings of Sri Lanka in 1973. This figure (10 per cent) does not include foreign resources required for new investment in the building materials sector. The percentage is probably much higher now.
d/ Crude estimate after oil price increases in 1973 and 1974. The largest component is from import of furnace oil: Import of gypsum and paper for cement bags also included under 'raw materials'.
e/ This figure is almost much higher today.
f/ Mostly blasting powder.
g/ Wholly imported.
Note: Discrepancies due to rounding.
Source: Ganesan (1979).

Table 6. Unit production costs of brickmaking

Process	Unit Production Costs (US cents per brick) (medium wage economy)	(low wage economy)
Capital-intensive all year round	6.5	6.2
'Least-cost' all year	3.1	2.3
'Least-cost' seasonal working only	2.9	2.0

Source: Keddie, J., Cleghorn, W. "Least Cost Brickmaking" in Appropriate Technology, vol.5, no.3, 1978.

It was found that buildings constructed in bricks and blocks varied in cost (according to techniques chosen) from $30 to $50 per square metre and in timber from $30 to $35 per square metre. On the other hand, the cost of construction in timber and bamboo was $15 per square metre, in mud $8 per square metre and in bamboo alone only $5 per square metre. Although the reliability of such figures can be questioned, they do give a rough indication of the order of magnitude of the differentials involved, showing that the least expensive basic construction material available costs 10 times less than the conventional bricks and blocks.

Of course, the quality of materials must also be taken into account. Thus, it is commonly known that a structure built with materials such as mud and bamboo may last for only a few years without repairs. However, it is sometimes possible to improve these basically 'impermanent' materials - thereby extending their life by a number of years. For example, the life of bamboo used in construction may be lengthened from 5 to 15 years by a process of impregnation. If 30 per cent is added for the cost of this treatment, the construction cost per square metre at $6.50 per square metre is still unrivalled. A study of traditional and modern materials used in house construction in Bangladesh revealed a cost differential of 13:1 in favour of the former, and, in this instance, it was estimated that, even if account is taken of the need to make constant repairs to traditional housing, traditional materials are still half the price of modern ones.

It should also be noted that the production of traditional building materials is particularly suited to small units. This is because the product is heavy, bulky and of low value, so that production in small units, located close to markets, offers significant savings on transport costs. Thus, the price differential on delivered costs of materials produced in small and large-scale units may be even greater than the foregoing comparisons imply.

As the total capital cost of the latter is also very much greater, the differential in terms of foreign exchange requirements between the two production processes is somewhere in the order of 200:1. In addition, the small-scale informal units operate their kilns using locally available sources of fuel, so that there is no imported element in the running costs - a fact that is confirmed by the data presented for brickmaking in table 5.

Table 5 also shows the foreign exchange requirements for the production of sand, earth, clay and lime to be nil. While there is an imported component in the production of tiles and aggregates, it is relatively small (10 and 12 per cent of output price respectively). This can be contrasted with the high foreign exchange costs involved in the production of steel and steel products (57 to 100 per cent of the output value respectively); paint (61 per cent); electrical fittings (51 per cent); sanitary pipes (43 per cent); hardware (38 per cent); and cement (24 per cent).

In terms of roofing materials (table 4), while there is no foreign exchange element in the costs of locally produced country tiles, for asbestos-cement the foreign cost element is 41 per cent of the value and, for g.i. sheets, it is an incredible 82 per cent - of particular significance in view of the apparent popularity of the latter in almost all developing countries.

Production costs

In addition to requiring less capital and foreign exchange, building materials produced in small-scale informal units require less machinery and equipment than their large-scale counterparts. The only significant input is unskilled labour. Thus, costs of production are also relatively low. A comparison of the costs of producing bricks, using alternative processes, is shown in table 6. It can be seen that unit costs range from 2 U.S. cents per brick in small-scale traditional industries to 6.2 cents in modern industrial plants (the differential is slightly less in highwage economies). Thus, capital-intensive methods for the production of bricks are three times more expensive than the least-cost alternative. An interesting comparison of costs/per square foot of finished construction product using different types of materials, was made by the ECE in 1967.

NOTES

1. For example, Kenya, the United Republic of Tanzania and the Ivory Coast. See Edmonds and Miles (1984).

2. Mtui, 1980

3. Ganesan (1982), notes that all raw material requirements for the local production of steel and hardware are imported as well as 80 per cent for the plywood industry and 20 per cent for timber industry.

4. Wells, 1984.

5. Frequently, costs of production are higher than those for similar imported items; local products are therefore heavily protected by tariffs and/or direct import restrictions.

6. Tackie (1981).

7. Tenga, Sauni and Marealle (1982).

8. World Bank (1978).

9. Abbas (1980).

10. Lubell, H. and McCallum, D (1978).

11. Based on Wells (1969).

12. Ganesan (1982).

13. Abbas, op.cit.

14. Ganesan, op.cit.

15. Radha Sinha in Sethuraman (ed.) (1984).

16. King (1977).

17. Parry, J.P.M. (1983).

18. See Appendix, see also Ganesan (1982).

19. The term was adopted by Gerry (1974) in his analysis of the variety of forms of production operating around the dominant capitalist mode in Dakar, Senegal.

20. Sethuraman, in his work for the ILO, distinguishes between informal sector enterprises existing primarily for employment creation, as opposed to small-scale enterprises primarily concerned with profit maximization (1981).

21. Steel was the first to introduce the term 'intermediate sector' in his work on Ghana (1977); he defines the sector as comprising enterprises with some investment in fixed capital assets, and a fixed place of business, but with less than 30 employees; in Ghana, more than 40 per cent of the manufacturing industry would fall into this sector, and the sector is also responsible for the generation of a greater volume of employment than is to be found in commerce and manufacturing in the modern sector.

22. See Moser (1983).

23. The question as to whether the relationship between the 'informal' and the 'formal' sectors of the economy is exploitative or benign has been the subject of considerable debate for a number of years. For an excellent summary and evaluation of the arguments, see Moser (1983).

24. Sutcliffe (1971).

25. Wells (1984), see also Ganesan (1983), who estimates a "leakage" of 55-80 per cent in Sri Lanka.

26. ILO Technical Memorandum on brickmaking (see Appendix).

27. Ganesan (1982).

28. House (1978).

29. Sethuraman (1981).

30. Child (on rural Kenya)(1983).

31. See Abbas, op.cit.
Ganesan (1983), op.cit.

32. ILO Technical Memorandum on brickmaking.

33. See for example, ECE, 1967.

34. ILO, op.cit.

35. Osorba (1981).

36. For example, the work of the Building Research Unit in the United Republic of Tanzania, supported by Norwegian aid.

37. See King (1977) and Schmitz (1982).

38. See the work of Sethuraman, Steel, Schmitz, House and Gerry, op.cit.

39. Gerry (1974).

40. See Steel (1977) for small manufacturing enterprises; Sethuraman (1984) for attempts to promote small industries in the rural areas; and various ILO studies on the promotion of small contracting firms.

41. See, for example, the work of Sethuraman, House, Schmitz and Muench, op.cit., among others.

42. Ofori (1980).

43. Parry, J.P.M. (1981).

BIBLIOGRAPHY

Abbas, Z.A. Evolution of construction and building materials in Indonesia. UNIDO Monographs on appropriate industrial technology No.12, Appropriate Industrial Technology for Construction and Building Materials. New York, United Nations, 1980.

Child, F.C. An empirical study of small-scale rural industry in Kenya. Working paper No.127, Nairobi. Institute for Development Studies. Nairobi, 1973.

Csorba, E. UNIDO experience in the small-scale building materials industry, use of indigenous materials, wastes and by-products. Paper presented at an Ad Hoc Expert Group Meeting on the Development of the Indigenous Construction Sector. Nairobi, November 1981.

Edmonds, G.A. and O.W.J. Miles. Foundations for change: aspects of the construction industry in developing countries. London, Intermediate Technology Publications Ltd., 1984.

Ganesan, S. Employment generation through investment in housing and construction. Unpublished Ph.D thesis. University of London, 1979.

_____ The construction industry in Sri Lanka. ILO-World Employment Programme, Research Working Papers, Technology and Employment Programme. Geneva, International Labour Organisation, 1982.

_____ The management of small construction firms: case study of Sri Lanka, Singapore, Hong Kong, Thailand, Philippines and Japan. Tokyo, Asian Productivity Organisation, 1982.

_____ Housing and construction: major constraints and development measures. Habitat International, 7:5/6, 1983.

Gerry, C. Petty producers and the urban economy: a case study of Dakar: ILO - WEP working paper No.2-19-101-1/WP8. Geneva, ILO, 1974.

_____ Petty production and capitalist production in Dakar: the crisis of the self-employed. In Bromley, R. (ed.), The urban informal sector: critical perspectives on employment and housing policies. New York, Pergamon Press, 1977.

House, W.J. Nairobi's informal sector: a reservoir of dynamic entrepreneurs or a residual pool of surplus labour? Working paper No.347.Nairobi, Institute for Development Studies, University of Nairobi, 1978.

ILO. ILO Technology Series, Technical Memorandum No.6. Small-scale Brickmaking. Geneva, ILO, 1983.

Keddie, J. and W. Cleghorn, W. Least cost brickmaking. Appropriate Technology, 5:3, 1975.

King, K. The African artisan: education and the informal sector in Kenya. New York, Heinemann, 1977.

Lubell, H. and D. McCallum. Bogota - urban development and employment. ILO-WEP studies. Geneva, ILO, 1978.

Moser, C.O.N. The informal sector reworked: viability and vulnerability in urban development. Paper presented at a UNCRD seminar on The Role of the Informal Sector in Urban Development. West Berlin, November 1983.

Mtui, A.L. The exploitation, use and development of indigenous building materials in Tanzania. Paper presented at a seminar on building materials organized by the National Construction Council of Tanzania. Arusha, 1982.

Muench, L.H. A final demand approach to the informal sector and implications for public policies. In The Urban Informal Sector in Kenya. Occasional paper No.25. University of Nairobi, Institute for Development Studies, 1977.

Ofori G. The construction industries in developing countries: the applicability of existing theories and strategies for their improvement - case study of Ghana. Unpublished Ph.D. thesis. University of London, 1980.

Parry, J.P.M. Development and Testing of roof-cladding materials made from fibre-reinforced cement. Appropriate Technology, 18:2, September 1981.

_____Technical options in brickmaking. Paper presented to an Intermediate Technology Workshop, Birmingham, 1983.

Schmitz, H. Growth constraints on small-scale manufacturing in developing countries: a critical review. World Development, 10:6, 1982.

Sethuraman, S.V. (ed.) The urban informal sector in developing countries: employment, poverty and environment. ILO-WEP study. Geneva, ILO, 1981.

Sethuraman, S.V. and E. Chuta. (eds). Rural small-scale industries and employment in Africa and Asia: a review of programmes and policies. Geneva, ILO, 1984.

Sinha, R. Rural industrialisation in China: In Sethuraman and Chuta (eds.). Rural small-scale industries and employment in Africa and Asia: a review of programmes and policies. Geneva, ILO, 1984.

Steel, W.F. Small-scale employment and production in developing countries: evidence from Ghana. New York, Praeger, 1977.

Sutcliffe, R.B. Industry and underdevelopment. New York, Addison-Wesley Publishing Co.,1971.

Tackie, F.I.A. The nature and importance of the informal sector in construction. Paper presented at an Ad Hoc Expert Group Meeting on the Development of an Indigenous Construction Sector. Nairobi, United Nations Centre for Human Settlements, Nairobi, 1981.

Tenga, Sauni and Marealle, Role of small-scale industries (SIDO) in promotion of building materials industry. Paper presented at a seminar organized by the National Construction Council, Tanzania. Arusha. 1982.

Tolnai, G. The growth of big industry and the domestic market in the Third World. Budapest, 1980.

Wells, E.J. The production and marketing of ballast in Kenya. Miscellaneous paper No.8. University of Nairobi, Institute for Development Studies, 1969.

_____ The structure of the building industry: institutional and administrative changes required for the adoption of appropriate building technologies. Paper presented to an Ad Hoc Expert Group Meeting, Amman, Jordan, December 1977.

_____ Unpublished report for the National Construction Council. Tanzania, 1984.

_____ The construction industry in the context of development: a new perspective. Habitat International (forthcoming), 1984.

World Bank . Ivory Coast, the challenge of success. A World Bank country economic report. Baltimore, Johns Hopkins University Press, 1978.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT)

FIRST CONSULTATION ON THE BUILDING MATERIALS INDUSTRY

Athens, Greece
25-30 March 1985

Distr.
LIMITED

ID/WG.434/2
10 January 1985

ORIGINAL: ENGLISH

Issue No. 1

DEVELOPMENT OF THE BUILDING MATERIALS INDUSTRY *

prepared by the

UNIDO secretariat

* This document has been reproduced without formal editing.

CONTENTS

Page

I. SUMMARY 3

II. THE CRITICAL ROLE OF THE BUILDING MATERIALS INDUSTRY IN CONSTRUCTION AND ECONOMIC DEVELOPMENT 4

Building materials industry 4

International pattern and past trends in production and consumption in the building materials industry 5

International trade 7

Long-term prospects for construction and constraints to the development of the building materials industry 8

III. THE NEED FOR PLANNING 9

IV. FINANCE 11

V. THE QUESTION OF SCALE 12

Minimum and maximum sizes of plants in the cement industry 14

Points for discussion 15

Notes 17

I. SUMMARY

1. The issue paper highlights the basic role of the building materials industry in the development process. It emphasizes the crucial importance of this industry to any economic development strategy since gross fixed capital formation takes place, to a large extent, in the form of construction work for which building materials constitute a major input.

2. In spite of a considerable increase in the production of building materials in developing countries, the growth of that industry has been lagging behind the growth of construction activities and this has led to an escalation of imports since 1970. Since even the gloomiest projections for growth in per capita GNP in developing countries indicate that domestic demand for building materials will at least double by 2000, the situation is unlikely to improve if present trends are allowed to continue.

3. On the basis of this, it is argued that there is a need for active measures to promote this industry in the developing world. Planning is essential given the long lead times involved in setting up production facilities for most building materials. Also, a major influence on the development of the sector was found to be the production scale of plants. The paper contends that socio-economic conditions in many developing countries favour the adoption of small-scale over large-scale plants.

4. On the basis of these points of analysis, the Consultation is requested to deliberate on the:

- Needs to be satisfied by the building materials industry in developing countries;
- Constraints to the development of the building materials industry;
- Measures of international co-operation to overcome those constraints.

5. The "Points for discussion" proposed to the Consultation are included in para.36 of this paper.

II. THE CRITICAL ROLE OF THE BUILDING MATERIALS INDUSTRY IN CONSTRUCTION AND ECONOMIC DEVELOPMENT

6. The problem of fixed capital formation is at the centre of any economic development policy. In industrialized economies capital formation tends to require a higher proportion of machinery and equipment than in countries with a poorly developed economic infrastructure which require a greater part of capital formation to take the form of construction works like residential and non-residential buildings, roads, bridges, dams, irrigation, land reclamation and canalization works, water supply, sewages, airport and harbour facilities, etc. It has been estimated that construction usually accounts for over 50 per cent of the total gross fixed capital formation (GFCF) in developing countries. This share tends to decline with higher levels of industrialization. 1/ *

7. Building materials are the most important input to the construction sector. Surveys in a number of developing countries show that the intermediate consumption of materials and supplies range from 37 per cent to 55 per cent of the total value of construction output. 2/ Thus, the building materials industry constitutes a critical prerequisite to the development of construction activities and of development in general. Experience in developing countries over the last few decades has shown that the lack of adequate development of this sector can lead to considerable delays in the implementation of development projects. Moreover, foreign exchange constraints due to high foreign indebtedness and slack exports impose severe external limitations to the development prospects of a great number of developing countries. In this context, due to its potential for import substitution, and its role in development, this sector constitutes a priority target for any national policy aimed at satisfying the needs of the population and decreasing import dependency.

Building materials industry

8. The economic contributions of the building materials industry cannot be separated from the construction industry which consumes its products. However, only a few industries produce exclusively for the construction sector. For example, this is the case in the production of cement and bricks.

---

* Notes are provided at the end of this paper.

However, in the case of the wood industry, the construction sector in developed countries consumes more than 50 per cent of the total production of sawnwood and wood-based panels. 3/ For the iron and steel industry construction represents 42 per cent of total steel usage in the USA 4/ and around 50 per cent in the developing countries of Asia and Far East. 5/ Because the output from these industries is also used by other sectors of the economy, factors other than trends in the demand of the construction sector may shape these industries' growth and vitality.

International pattern and past trends in production and consumption of the building materials industry

9. Construction activity constitutes the outlet for building materials and as such indicates trends in demand for building materials. The value added in the construction sector is very unevenly distributed between developed and developing countries. In 1980, 74 per cent of the world population lived in developing countries, but they generated only 20,5 per cent of the world's gross domestic product and accounted for around 18 per cent of the world's construction value added. 6/ This was despite a period of high growth rates in developing countries, when both construction and GDP increased at significantly higher rates than in developed countries.

10. Trends of the growth rates of construction activity differ among geographical regions. In Africa, the growth in construction rose sharply from an average of 2.2 per cent annually in the early 1960s to 12.6 per cent in the mid-1970s, but fell to 7.9 per cent in 1978-80. Latin America and the Caribbean experienced their peak growth rates in the early 1970s with 8 per cent annually, but then declined steadily to 6.5 per cent in 1978-80. Construction growth in Asia reflects the oil boom and its impact on infrastructure and building investment in the Middle East and the rapid industrialization in the Far East in the 1970s.

Table 1

Average annual growth rates in GDP, industry and construction in developed and developing market economies

	1960/65	1965/70	1970/75	1975/80
Developed market economies				
- GDP	5.3	4.9	3.2	2.8
- Industrial activity	6.3	5.4	2.5	3.3
- Construction	6.2	3.7	0.8	0.5
Developing market economies				
- GDP	5.5	6.3	6.3	5.3
- Industrial activity	8.6	8.8	6.6	4.4
- Construction	4.9	7.2	8.3	9

Source: UN-Yearbook of National Accounts Statistics, 1981.

11. The production of building materials in developing countries has, however, been lagging behind the growth of construction activities. As can be seen from the figures in Table 2, the growth in construction has been higher than that in the production of almost all building materials implying that these countries have had to meet the increased demand for building materials through increased imports.

Table 2

Growth rates in GDP, construction and building materials production in selected developing countries, 1975-1980

	Egypt	Kenya	S.Arabia	Thailand	Malaysia	Korea	India	China	Argentina	Mexico
Population	2.6%	4.6%	3.0%	2.5%	2.5%	1.6%	2.1%	1.4%	1.3%	3.9%
GDP	9.8%	5.7%	10.6%	8.8%	10.2%	8.8%	13.9%		2.1%	7.6%
Construction	42.1%	4.9%	13.5%	18.9%	16.3%	15.5%	12.7%		7.8%	8.3%
BLDG. MTLS PRODUCTION										
Plywood	-6.3%	3.6%		14.9%	4.3%	3.6%	8.3%	10.6%	-2.6%	26.2%
Glass						17.0%	12.5%			6.3%
Build. Bricks, clay	-8.0%	-4.0%				-5.6%				
Quicklime	1.8%		31.8%			22.0%	24.4%			
Cement	0.4%	8.5%	33.6%	7.0%	12.5%	10.9%	1.9%	14.5%	7.2%	9.3%
Asb.+ Cem. Art/s							6.6%			7.9%
Concrete blocks		116.4%				102.5%				
Cr. Steel, Ingots	32.3%			18.5%		36.8%	3.8%	11.1%	5.4%	7.0%
Angles, Shapes, etc.					8.9%	28.3%				4.5%
Aluminium						3.9%	2.0%	5.7%	101.0%	1.4%
Nails, Screws, etc.	6.8%					39.8%	0.8%			

Source: UNIDO World-Wide Study on the Building Materials Industry, 1985.

International trade

12. The construction industry in many developing countries is dependent to a large extent on imported building materials. In some countries of Africa, over 90 per cent of the value of building materials used in the formal construction sector is accounted for by imports. 7/ Table 3 indicates that the import bill of the developing countries for building materials is escalating rapidly, from US$ 6.1 billion in 1970 to US$ 49.4 billion in 1980. While developing country exports also increased during this period (from US$ 2.8 billion in 1970 to US$ 19.8 billion in 1980), the result was nonetheless a large negative balance of trade. Developing countries' net imports of building materials amounted to $US 3.3 billion in 1970; to US$ 18.2 billion in 1975; to US$ 29.6 billion in 1980; and to about US$ 35 billion in 1982. Hence, building materials represented a considerable drain on scarce foreign exchange in the developing world at precisely the time when developing countries could least afford it. In fact, a very large number of developing countries are so constrained to keep tight control over their expenditures for the import of goods and services that the importation of investment goods, including building materials, are permitted only for essential projects. Many of the other development projects can not be realized due to unavailability of foreign exchange to import the required imports.

Table 3

Trade in building materials, 1970-1980
($US million)

Origin \ Destination	Year	Developed market economy countries	Developing countries	Socialist countries EE and Asia
Developed market economy countries	1970	16.982	4.734	1.277
	1975	36.417	20.377	6.667
	1980	76.602	38.203	8.409
Developing countries	1970	1.882	800	162
	1975	3.258	2.270	480
	1980	10.385	8.450	950
Socialist countries of Eastern Europe and Asia	1970	1.047	570	n.a.
	1975	1.926	1.560	n.a.
	1980	3.881	2.720	n.a.

Source: UNCTAD 8/

Long-term prospects for construction and constraints to the development of the building materials industry

13. Irrespective of the prospects for the recovery of the world economy, the evolution of world prices, interest rates and international debt arrangements, some trends can be sketched about the future demand for construction and building materials by various groups of countries.

14. In the developed market economies, the declining ratio of construction investment to gross fixed capital formation and also to gross domestic product observed since the sixties is very likely to continue in the future. Due to this and decreasing growth rates of population, construction is likely to grow at very low rates.

15. In developing countries the construction needs will certainly increase in the years to come if only due to the growth in population which is likely to occur. Projections indicate that the developing world's population will increase from 3,3 billion in 1980 to 4,8 billion by the year 2000,[9/] and the high urbanization rates will require additional housing and infrastructure. The question remains open as to how far the housing needs of developing countries can be satisfied in the present economic, social and political environment. It should be borne in mind that a large number of the unemployed and low-income earners are not in a position to afford even the cheapest dwellings offered on the market. [10/] A large part of these housing needs will probably be met by the informal sector. [11/] On the other side, development projects will require immense amounts of building materials to develop the industrial, transport, communication, energy and social infrastructures. The amount of resources to be spent on housing or on non-residential building and civil engineering is obviously a political choice.

16. The correlation existing between growth of GDP and construction permits a rough prediction of future demand for building materials. According to three scenarios sketched by the UNITAD model, the demand for construction and building materials will grow significantly through 1990 in all developing countries. [12/] Even the gloomiest projections for growth in per capita GDP in developing nations indicate that domestic demand for building materials will at least double by the year 2000. [13/]

17. In order to meet this demand, developing countries will have to take measures to overcome the constraints which hamper the development of their building materials industry. The main constraints which require priority attention have been identified as follows:

- lack of long-term planning and co-ordination of development policies;
- lack of adequate financial resources;
- concentration of investment in capital intensive plants with poor project conception and inappropriate technologies;
- poor management practices and lack of skilled manpower;
- lack of adequate standardization and quality control;
- existence of outmoded building codes and regulations;
- inadequate research, technology and information infrastructure. 14/

III. THE NEED FOR PLANNING

18. It was suggested in the previous chapter that the output of building materials in developing countries is generally insufficient to satisfy demand. Building materials needs usually exceed effective demand in these countries to a great extent, and will therefore force governments to undertake deliberate policy choices on what type of demand to satisfy and with what kind of resources. In fact, if current trends are allowed to continue without any effort to overcome the imbalance between the supply and demand of building materials, the gap is bound to increase. A prerequisite to any well conceived policy decision is (a) on the demand side: an inventory and assessment of present and future needs, and (b) on the supply side: an inventory of resources.

19. The lead times involved in planning, designing and installing production facilities for building materials, especially those for cement and steel, can be as long as 5 and 10 years for conventional plants. As a consequence the ability to forecast demand accurately for the long term is necessary for planning the expansion of existing productive facilities or the installations of new ones.

20. Since almost every development action has an important construction component and a building materials demand, these activities have to be carefully catalogued in order to obtain a comprehensive assessment of building materials requirements. A first step in this direction would be to disaggregate construction demand according to its final use: housing,

non-residental building and civil engineering. [15/] A further distinction should be made between construction in the formal and the informal sector. The use of annual budgetary programmes might constitute an instrument to monitor public construction demand.

21. The importance of a well established resource inventory cannot be overestimated. In the first place, such an inventory may help to determine the extent to which the satisfaction of needs is restrained by limited natural resources and/or lack of effective demand, i.e. lack of purchasing power. In the second place a supply inventory could ascertain whether or not the demand for specific building materials could be met by the capacities of the existing industries.

22. Inventories of needs and supply will allow planners to decide on alternative end uses of the building materials (e.g. housing, infrastructure, etc.), and to define product mixes and production targets. At present, few development plans in developing countries contain target figures for construction or even point out its relationship with other sectors. In the building materials industry it is usually only cement, steel and eventually glass which figure in quantitative targets.

23. Planning is of great importance for the development of this sector in developing countries. Where indicative planning is used targets will have to be determined to co-ordinate private and public sector investment and output. Under a centralized (or directive) planning system, production and investment will have to be set on the basis of forecasts of demand and decisions on the allocation of resources. But even in countries which base their economic policy on the market forces, long-term forecasts of demand and supply inventories of resources will be necessary for promotional measures for the industry. Also, in branches which by their size are likely to have a monopolistic position, a price and location policy will be necessary (e.g. in the cement and steel industries).

24. An example of different policy instruments which could be used to promote the building materials industry can be found in the Mexican Industrial Plan for 1979. This Plan envisaged the reorientation of industrial production towards basic or essential consumer goods, the promotion of small-scale producers and the decentralization of industry as well as the employment of labour-intensive technologies. For this, the Plan identified specific

instruments, which in the case of building materials were as follows: (a) purchasing policy of the government in favour of domestic suppliers; (b) pricing subsidies on energy for new enterprises; (c) financial support to enterprises operating in priority geographical areas as well as small and medium enterprises; (d) tariff protection; and (e) tax incentives for private investment in priority areas, both sectoral and regional with the objective of encouraging higher levels of employment. 16/

IV. FINANCE

25. The most important determinant in the establishment of building materials industries by developing countries is the capital cost investments and working capital for industrial installations. For steel, the capital costs (per ton of steel) are considerable; in 1963 it was estimated that the capital cost was US$250. In 1976 the annual cost per ton of capacity installed in steel in the United States was assessed at US$800 to US$1,000 in the case of entirely new units, and US$350 to US$500 for modernization and expansion operations. 17/ Other estimates offered in the late 1970s, range as high as US$1,300 for new, large, integrated installations, and US$490 for steel made from the direct reduction/electric furnace. These figures reflect rapidly rising prices. In developing countries, the costs of integrated plant installation and expansion are even higher.

26. The capital required to establish a cement industry is less than that for steel but high in absolute terms for developing countries when the production units involved are large. Table 4 shows that in 1978 in India the investment per ton of installed cement making capacity was Rs. 741.25, or approximately US$75 for a 1,200 ton per day operation, and Rs. 597.29 or approximately US$60 for a 50 ton per day capacity plant. Thus, for a unit with a 400,000 annual output capacity, the minimum outlay required was US$ 30 millions. More recent information indicates a cost of US$125 million 1982 for a cement plant with a 750,000 t/year capacity set up near a port. 18/

Table 4

Minimum capital costs of production of cement, brick, and steel in developing countries

	Fixed Capital Investment	Working Capital	Total Investment
Bricks * ((US$1,000)			
Tunnel kiln **	2,086.0	95.0	2,182.0
Hoffmann kiln **	1,860.0	90.0	1,950.0
Cement *** (per ton in US$)			
400,000 tons/annum	71.0	3.1	74.1
16,500 tons/annum	55.8	3.9	59.7
Steel			
Integrated Units			2,000.0
5 mill. ton, Venezuelan, US$per ton			2,000.0
0.5 mill. ton, Algerian, US$per ton			
Semi-integrated			
100,000 tons, Paraguay, US$per ton			800.0

* 1975 dollars.
** Each plant has a daily output of 60 tons of perforated bricks, 2.5 kg weight (UNIDO, 1978).
*** Cement Research Institute of India, 1978.

Source: Moavenzadeh, Fred, "Global Prospects for Concrete Construction", Concrete International, February 1984.

V. THE QUESTION OF SCALE

27. In the last few decades, many developing countries seeking a path towards accelerated industrialization, have been favouring the import of the most modern technology available in industrialized countries, which tends to be large-scale and capital-intensive. Substantial capital investment, coupled with a strong belief in the benefits of economies of large scale, brought about the creation of large-scale enterprises throughout the developing world in the 1950s to the 1970s, which resulted in many cases in the under-utilization of production capacity, low productivity and low absorption of complex technological processes.

28. The above-mentioned experience, coupled with external constraints due to the increased indebtedness of developing countries and the increased costs of capital in the international financial markets, have led to a reassessment of the question of the benefits of large-scale over small-scale plants. Moreover, even where economies of scale exist in large-scale plants resulting in lower prices at the factory gate, they are very often offset by high transportation costs leading to high prices for the consumer.

29. In the building materials industry it has been established that the following main factors influence the choice of appropriate plant scale:

(a) Market size

The geographic size of the market base is determined, to a large extent by the availability of transport facilities. The manufacture of building materials requires large quantities of raw materials, and produces bulky and/or heavy goods. But the low value/weight ratio of many building materials renders transportation costs a more serious constraint than for virtually any other industry. Where transportation is difficult, as in mountainous terrain, or roads are poor or unpaved, transportation costs can be higher than production costs for certain goods. For example, in the Sudan, Honduras and Botswana, the transportation cost of cement over 100 miles exceeds its cost of production.

The constraint of transport cost varies inversely with the size of the consumer market for building materials. Were there are large enough markets to sustain economies of large-scale production within a reasonable distance of the manufacturing site, the constraint imposed by transport costs would be eliminated. However, a market limited by the absolute size, density, purchasing power or income of the population poses a serious constraint on the establishment and viability of large-scale building materials industries.

The market base expands and contracts in response to varying demand and the availability of transport. These changes call for a building materials industry able to adapt easily to varying conditions, and therefore flexible as to scales of production and possibly even portability of factories.

(b) Labour and capital availability

In developing countries, investment capital is scarce, while the supply of unskilled labour appears limitless. Under these circumstances, the import of technologies requiring large amounts of capital and offering few employment opportunities may constitute a poor utilization of factors of production.

(c) Skilled labour and management

Capital-intensive technology often reduces the need for unskilled labour, but it increases the requirement for workers skilled enough to run complex machinery. Finding sufficiently trained workers for this is often difficult. An increase in the scale of production normally entails a need for more materials, machinery and labour, which leads to the growth of the administration, and an increase in the need for supervisors and managers. Middle management is often scarce in developing countries and its lack may create serious bottlenecks in the organization of production.

(d) Technological complexity

An increase in technological complexity was intitially heralded as the means of maximizing the quantity of products made available to a country's population, and hence its social welfare. Yet a system that works efficiently in the industrialized world cannot simply be transferred to a developing country with similarly positive results. Technologically complex plants require auxiliary facilities often unavailable or extremely expensive in the developing world: sophisticated transport facilities, loading and unloading machinery, storage and distribution systems, warehousing for spare parts, large machine shops, etc. These additional facilities can increase overhead costs substantially.

30. Additional pitfalls may accompany the adaptation of complex, large-scale technologies to conditions in developing countries. Chief among them is the high possibility of a machine breakdown, particularly one that cannot be handled by a local repairman. A second problem is that plants are frequently operated at less than full capacity because market size may not warrant high production.

Minimum and maximum sizes of plants in the cement industry

31. The problem of the choice of plant scale can be illustrated by the case of the cement industry. The technology used in this industry seems to have undergone similar changes in developed countries as have other building materials industries like brickmaking, woodprocessing, steel production, etc.

32. Throughout this century the trend in the cement industry has been towards steadily increasing scales of production, and in the last decades towards automation. 19/ The average size of kilns installed during the 1970s was of 2,500 tons per day (tpd) and more recently a number of kilns with capacities over 4,000 tpd were installed. However, in some developed countries (such as the USA) the trend seems to be toward a system of smaller-scale cement plants. This seems to be due to a number of factors, such as pollution control regulations, high fuel prices which made transport of cement too expensive and favoured the installation of smaller scale plants close to various markets. This trend has been helped by the technological advances made in the design of small-scale plants, like e.g. improvements in design of the vertical kiln.

33. At the other end of the scale, plants producing cement at a scale of 50, 30, 20 and even 10 tpd have been produced in some developing countries as for

instance India and China. Finally, cementing materials can even be produced on a cottage-industry level. The difference between these two extremes is not just one of scale of production. The properties and uses of the materials made are different, as is the technology involved. But it is significant that there is active development work being carried out on different sized plants and it is becoming increasingly clear that there is no one "best" or "most appropriate" technology for the production of cement.

34. Apparent economies of scale in cement production can be substantial but in practice these economies of scale might not be realized in developing countries. Actual performance of large plants frequently fails to match forecasts and projections used in feasibility studies. Actual outputs of around 50 per cent of rated capacity are common, and total financial investment, plant operation sophistication and increased construction time all increase with expanding plant size. Another factor is that large-scale cement works have a very long start-up period. In fact, they do not begin to operate at full capacity until four to six years after construction.

35. Production in a few small plants could offer direct savings in transport costs coupled with more assurance of supply through a multiplicity of suppliers. Of course, dispersed production in small-scale plants would be possible only if the raw materials (mainly limestone and gypsum) are generally available. Fortunately these materials are widely available in most countries, and a further advantage of small plants is that they can usefully exploit small deposits of these materials. Another advantage of dispersed cement production associated with production in smaller plants is that easier availability of cheaper cement in rural areas is likely to promote construction of rural infrastructure and spread the benefits of development more evenly.

Points for discussion

36. The Consultation is invited to consider the following:

(i) What are the needs the building materials industry will have to satisfy in developing countries in the years to come? How can these needs be assessed and projected on an national, regional and interregional basis? Could a core list of building

materials required by developing countries be established? What are the constraints of developing countries to develop production of these building materials?

(ii) What measures could be adopted to improve planning for the development of the building materials industry? What is the role of international co-operation toward this end?

(iii) Is the question of scale relevant for the development of this sector? What are the possibilities and constraints of small-scale manufacture of building materials, and what measures could be taken to promote such small-scale plants?

Notes

1/ J.R. Riedel, Siegfried Schultz, "Construction and building materials industry in developing countries", Economics, 1980, Vol.21, p.40.

2/ Fred Moavenzadeh, Measures and actions to increase the production of indigenous building materials in the context of enhanced import substitution, UNIDO, ID/WG.425/3, 1984, p.14.

3/ ECE/FAO, European Timber Trends and Prospects 1950 to 2000, Geneva 1976, p.35.

4/ UNIDO, World-Wide Study on the Building Materials Industry (1985).

5/ ibid.

6/ Based on data from UN-Yearbook of National Account Statistics, 1981.

7/ ECA, Needs, constraints and prospects of African countries regarding the availability of building materials, 1983 (mimeo), p.2, paper presented at the Symposium on Appropriate Building Materials for Law Cost Housing in the African Region.

8/ UNCTAD, Tariff and non-tariff obstacles to international trade in building materials, Geneva, 1984 (mimeo).

9/ United Nations, World Population Trends and Policies, 1981.

10/ According to World Bank data of 1975, between 30 per cent and 80 per cent of the population living in large Third World cities (World Bank, Housing: Sector Policy Paper, Washington, 1975).

11/ See Issue Paper No.3, ID/WG.434/4, 1985.

12/ J.R. Riedel, Global Prospects for the Development of the Construction and Building Materials Industry, Munich 1983 (mimeo), p.29-36.

13/ UNIDO, World-Wide Study on the Building Materials Industry (1985).

14/ ECA, Needs, constraints and prospects of African countries regarding the availability of building materials, 1983, and UNIDO, Report of the Global Prepartory Meeting for the First Consultation on the Building Materials Industry, ID/WG.427/7, 1984.

15/ J.R. Riedel, Long-term forecasting and planning of the construction and building materials industry, UNIDO, ID/WG.425/2, 1984.

16/ Plan Nacional de Desarollo Industrial (1979), México.

17/ Fred Moavenzadeh, ibid., p.24.

18/ Sid Boubekeur, Outline of a policy for mastering capital goods technology, UNIDO, ID/WG.424/4, 1984, p.27.

19/ UNIDO, Optimum scale production in developing countries, Sectoral Studies Series No.12, p.41-51.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT)

FIRST CONSULTATION ON THE BUILDING MATERIALS INDUSTRY

Athens, Greece
25-30 March 1985

Distr.
LIMITED

ID/WG.434/2/Add.1
26 February 1985

ORIGINAL: ENGLISH

Issue No. 1

DEVELOPMENT OF THE BUILDING MATERIALS INDUSTRY

Addendum

FINANCING OF THE BUILDING MATERIALS INDUSTRY IN DEVELOPING COUNTRIES *

prepared by the

UNIDO secretariat

* This document has been reproduced without formal editing.

V.85-23837

1. The reader is referred to the Issue Paper 1, entitled "Development of the building materials industry" (ID/WG.434/2) and to paragraphs 25 and 26 on the cost of cement plants and to paragraphs 27 to 35 on the question of their scale.

2. The Global Preparatory Meeting (Vienna, 24-28 September 1984) recommended that the present Consultation consider the following subject: the development of the building materials industry, including financing, planning and programming methods, emphasizing alternative scale plants, particularly in the cement industry. It also requested that UNIDO prepare studies on the financial implications of cement plants of different sizes.

3. In the intervening period, the UNIDO secretariat has carried out some further investigations on the financing of the building materials industry. These have revealed a considerable lack of information which, particularly in the short period of time, has made it impossible for the UNIDO secretariat to carry out a full study on the subject, and in particular on the financial implications of cement plants of different sizes.

4. It is the intention of the secretariat to examine certain subject areas and to report on the findings to a possible Second Consultation on the Building Materials Industry. The objectives of the UNIDO secretariat are to:

(i) Examine the terms, conditions, maturities and modalities of external finance for the construction of plants for the production of different building materials;

(ii) Assess the implications of the policies of lending by various sources of external finance in the development of the building materials industry in developing countries;

(iii) Assess the various negotiating techniques and possible avenues for obtaining external financing for investment in order to obtain the greatest degree of national autonomy in the formulation, implementation and operation of the project.

5. To facilitate the work of the secretariat, information falling into the following categories is required:

(i) Historical information on the involvement of different external financial sources (World Bank, IC export credit agencies etc.) in investment in the sector (project by project if possible);

(ii) Local investment for these projects, their purpose, and magnitude in total investment;

(iii) Relationship (if any) of differences in initial cost of plant and equipment with different sources of finance;

(iv) Analysis of differences in realized costs (= initial capital cost and debt service and interest) by source of finance, i.e. multilateral lending, bilateral ODA, export credits, own resources, commercial borrowing;

(v) Differences in envisaged investment and realized investment due to which factors, i.e.:

- increase of capital equipment cost;
- time delays in project implementation;
- changes in terms and conditions of finance;
- others.

(vi) The influence of different financial sources on:

- scale of project;
- choice of technology;
- country or source of supply of capital equipment;
- discrimination against local project management and consultancy services etc.;
- discrimination against local capital components.

(vii) Financial problems relating to development of infrastructure and training;

(viii) Dissonance between institutional criteria of the bankability of projects and national development priorities, i.e. some assessment of why projects were rejected by either side or projects of one type were substituted for others;

(ix) Main negotiating guidelines for unpackaging finance and technology and retaining national autonomy in project formulation, evaluation, technical specification, and construction.

6. In addition, to facilitate the contribution of information specific to the cement industry, a special questionnaire has been prepared and is annexed to this Note. It is hoped that participants will provide answers to the questions posed in the near future.

First Consultation on the Building Materials Industry
Athens, Greece, 25-30 March 1985

QUESTIONNAIRE TO PARTICIPANTS ON THE FINANCING OF THE CEMENT INDUSTRY

Introduction

The Global Preparatory Meeting for the above Consultation was convened in Vienna from 24 to 28 September 1984 and was attended by 25 participants from 20 countries, representatives from United Nations bodies, non-governmental organizations and several observers.

The meeting noted the diversity of this sector and the crucial importance of the cement industry and requested UNIDO to prepare appropriate documentation, including studies on the financial implications of cement plants of different sizes. It, therefore, recommended that alternative scale plants be examined. Furthermore, the current trend in some developed countries towards small-scale plants as well as the experience acquired by some developing countries in this area could also be taken into account.

To enable the UNIDO secretariat to prepare this documentation, it would be appreciated if the following questions could be answered on the basis of your experiences in the development of this sector in your country.

Questions pertinent to the development of the cement industry

(It is understood that any information provided will be treated confidentially)

1. Indicate how many cement plants and of what different sizes have been constructed in your country over the past five years?

   i) What is the present and the projected future demand for cement for the next five years?

   ii) Is the present demand for cement met by local production or imports?

   iii) What is the present installed capacity vis-á-vis actual poroduction?

   iv) Did you achieve the projected production target?

   v) What is the current local factory cost (ex. factory compared to cost of imported products (CNF)?

vi) What is the expected production situation over the next five years? Will it be advantageous to expand local production, to create in the future new plants or to continue to import?

vii) If local production is an advantage, indicate any illustrative cement plants.

viii) If the actual production falls short of the installed capacity, have you identified the reasons for it?

ix) Where was technology obtained from? (i.e. turn-key, with foreign partners, joint ventures or under licensing agreement)

x) Do you need assistance to improve the efficiency of the plant? If so, what type of assistance do you need?

2. If the basic raw materials for cement production are available and you are interested in setting up a new cement plant, are feasibility studies available?

If so, who prepared them and how were they financed? Do you need UNIDO's assistance in preparing feasibility studies?

3. Which sources of financing/financing institutions did you contact for the construction of cement plants in your country?

i) What was their reaction and what difficulties did you face?

ii) Does your Government's industrialization policy provide opportunities/facilities for foreign investment in this sector?

iii) Where did you ultimately obtain the financing from?

iv) Can the cement company's balance sheets be made available?

v) Can you provide the operating figures, including profit and loss accounts for the last three years, if available?

vi) Do you need assistance in contacting foreign investor groups to establish new cement plants or to expand existing ones? Can UNIDO assist you in this respect?

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT)

FIRST CONSULTATION ON THE BUILDING MATERIALS INDUSTRY

Athens, Greece
25-30 March 1985

Distr.
LIMITED

ID/WG.434/3
11 January 1985

ORIGINAL: ENGLISH

Issue No. 2

MEASURES TO STRENGTHEN INDIGENOUS TECHNOLOGICAL CAPABILITIES IN THE PRODUCTION OF BUILDING MATERIALS *

prepared by the

UNIDO secretariat

* This document has been reproduced without formal editing.

V. 85-20608

CONTENTS

	Page
I. SUMMARY	3
II. INTRODUCTION	4
III. CHOICE, RESEARCH AND DEVELOPMENT OF PRODUCTS	4
IV. SELECTION AND ACQUISITION OF TECHNOLOGY	7
V. TRAINING	10
VI. PRODUCTION AND ADAPTATION OF EQUIPMENT	11
Points for discussion	12
Notes	13

I. SUMMARY

1. The issue paper examines the need of developing countries to strengthen their indigenous technological capabilities and the measures which should be taken at the national, regional and international level in this respect.

2. The paper examines the efforts required to widen the scope of building materials based on locally available resources. While the majority of these efforts are needed in the fields of research, standardization and quality control, special attention has to be paid to the dissemination of research results among consumers and industry. It also asserts that existing building codes and regulations very often hamper the use of indigenous building materials and have to be updated and adapted to local conditions.

3. Most enterprises in developing countries, when confronted with the selection of equipment, are handicapped by the lack of proper information and advice. Therefore, it is suggested that industrial information systems and consultancy services at the local level should be strengthened as well as the negotiation capabilities of decision-makers.

4. The paper also asserts that training of skilled workers as well as improvement of managerial capabilities is needed. It points to the desirability of mastering the design and production of capital goods for the manufacture of building materials. It is, therefore, suggested that developing countries, according to the degree of their development, establish the necessary conditions for the production of single tools, capital goods of low technological complexity and spare parts.

5. The Consultation is requested, inter alia, to deliberate on the:

- Ways and means of strengthening indigenous technological capabilities for the production of building materials in developing countries;
- The role of international co-operation towards this end.

6. The detailed points proposed for discussion by the Consultation are included in para.35 of this paper.

II. INTRODUCTION

7. Many developing countries do not have clear policies regarding the ways and means to increase the production of building materials in order to cope with the increasing demands in the years to come. A strategy to develop the local production of building materials has to be based on an assessment of the needs and available resources and on the need to master the technology for producing suitable materials. This involves a number of related problems. In the first place, based on an assessment of existing resources, countries will have to choose products for which they have adequate raw materials. This implies the establishment of raw materials inventories and undertaking research for the development of products based on those resources. Once the choice of products has been made and local production is envisaged, the developing countries will have to solve the problems related to the choice of technology, its adaptation to local needs and the training required at all levels to use the technology. An important step in the development of a self-sustaining building materials industry is the mastery of design and production of required capital goods. This issue paper discusses each of these aspects and the measures to strengthen indigenous technological capabilities in the production of building materials.

III. CHOICE, RESEARCH AND DEVELOPMENT OF PRODUCTS

8. Most developing countries have established their patterns of consumption of building materials on the basis of construction techniques - and as a consequence the building materials - used in developed countries. This has led to a considerable import dependency of the construction industry and to a prejudice and neglect of the locally-produced materials. In a situation of reduced foreign exchange availability, most of these countries cannot continue to devote an important part of their foreign exchange earnings to the importation of building materials and have therefore to find ways to promote import substitution in this sector.

9. The wealth of natural resources suitable for conversion into building materials has not been adequately utilized in many regions. There is a general dearth of adequate information on the raw materials required for the production of building materials. In most cases, information on the location of raw materials is available, but an evaluation of the extent and quality of reserves is lacking. In the absence of such an evaluation it becomes

difficult to determine the suitability of the raw materials to support production ventures.

10. The choice of products and the scope for substitution varies from one type of construction to another. For example, the range of materials suitable for use in civil engineering projects is normally quite limited: cement, steel, bitumen and a variety of aggregates and filling materials are the main materials consumed by the sub-sector. However, considerable progress has been made in the last few years in the promotion of other materials, such as wood, for structural purposes.

11. In contrast to civil engineering structures, in housing and residential buildings there is a wide range of possible choices of building materials. For example, it is generally accepted that in some construction applications, the superior strength qualities of portland cement are not essential and that substitute binders like lime and lime-pozzolana could be used to achieve the desired results. Even though most countries have raw materials for the production of lime (in the form of limestone, dolomite or sea-shells) and there is a wide range of technologies available for its production, not much has been done to increase the supply and promote its use in building.

12. Large deposits of natural pozzolana can be found in countries which have experienced volcanic activities in the past. Artificial pozzolana can be produced from clays, bauxite waste and the burning of rice-husk. In some countries of Asia, commercial plants are in operation for the production of cementitious binder from rice-husk ash and lime. It has also been found that ashes from the burning of rice straw, dried banana leaves and bagasse show good pozzolanic properties. To increase the use of these materials, adequate promotion activity backed by research and development work is required.

13. Wood has for a long time been neglected as a building material in developing countries, in spite of the fact that many of these countries have important underutilized forest resources. Many factors have contributed to this: building codes and regulations; prejudices against the behaviour of wood under fire or biological factors; insufficiency of the productive sector; etc. Experience in developed countries has shown that wood is a good building material and great improvements have been made to increase its durability and fire resistance. Timber and wood panel materials have a great

potential for use in construction, for structural purposes in simple housing frames one or two storeys, bridges, etc. as partition and fill material, and for exterior and roof covering. The First Consultation on the Wood and Wood Products Industry discussed the promotion of the use of wood in construction in developing countries. It recommended that research on the properties of wood, especially of the less accepted species, should be increased, that information on existing and new uses of wood in construction should be disseminated in developing countries, and that training related to the use of wood in construction be promoted. 1/ *

14. Soil is the most extensively used building material in rural areas in the developing world. In India, for example, according to the 1971 Census there was a total housing stock of 93.0 million dwelling units in the rural areas out of which 72.2 per cent employed mud as their principal building material, particularly for walling in one way or another. Extensive studies undertaken in research laboratories all over the world, have led to recommendations on construction techniques that would help to prolong the service life of earth buildings. These include incorporation of stone or other masonry foundations, use of agricultural fibres to reduce shrinkage, use of extended overhangs at the eaves and use of low-cost protective coatings. Research made on stabilization of soil has shown that its strength properties can be improved by using cement, lime, bitumen, and other chemical compounds. It must be recognized, however, that most of these innovations have not found widespread application. Successful promotion of those will depend on the capability of governments to limit public prejudice against unbaked soil materials, the improvement of the technical know-how of potential users, and the increase in the availability of some products (e.g. stabilized soil blocks) by mass-production for sale to the public.

15. In many developing countries the absence of standards and quality control of locally produced building materials has negatively affected their use in construction. Efforts to develop national and regional standards are needed, since their establishment and acceptance would greatly promote the use of indigenous building materials and also increase international trade. Also, outdated building codes and regulations in many developing countries constitute a barrier to the use of indigenous building materials. The

---

* Notes are provided at the end of this paper.

reformulation of codes and their adaptation to local conditions would make them a valuable instrument for a more rational use of available raw materials in construction. 2/

16. A number of actions are necessary to broaden the choice of building materials and to make better use of available resources. Information on existing deposits of underutilized raw materials has to be collected and processed. Considerable research efforts are required to develop "new" building materials, to encourage the use of agricultural waste materials and to improve standardization and quality control. The transfer of these research results and developments to the manufacturers seems to cause some difficulty despite the construction of pilot plants and demonstration units in several locations. Mechanisms to establish improved co-ordination between research institutions and end users will have to be developed to ensure that researchers are aware of the problems of industry and also to guarantee that the results of research are disseminated to the productive sector. 3/

IV. SELECTION AND ACQUISITION OF TECHNOLOGY

17. Most surveys conducted on this sector in developing countries show a situation of underutilized capacities caused by the inadequacy of the existing equipment, the lack of trained manpower and deficiences in the organization of production. In the case of the cement industry many countries which have opted for large highly automated plants are facing very low capacity utilisation. In brickworks it was found that mechanized units tended to operate close to the production capacities, whereas automated brickworks faced serious constraints.

18. In the ESCAP region underutilization is usually caused by interruptions in supply of raw materials and other inputs, equipment breakdowns, and difficulties in obtaining spare parts, lack of skills and motivation among workers due to high turnover and poor organization, and shortcomings in planning and management. Another cause for underutilization has its origin in the choice of technology adopted, which may impose a scale of production in excess of that which the local market can support. 4/

19. Recent surveys, sponsored by ECA, of cement plants in Benin, Ghana, Ivory Coast, Liberia, Nigeria, Senegal, Togo and Burkina Faso showed that for

integrated cement plants the rate of capacity utilization in 1982 ranged between from 15 to 90 per cent with an average of 65 per cent. The capacity utilization in clinker grinding plants for the same year ranged from 33 to 87 per cent with an average of 57 per cent. The factors underlying the apparent poor performance of building materials plants in African countries are many and varied, and include the following:

- Poor project conception including use of inappropriate technologies, overestimation of demand at the planning stage, lack of foreign exchange to purchase needed spare parts and (sometimes) importation of raw materials to keep plants running.

- High energy costs.

- Poor management practices and lack of the requisite skilled manpower. The effect of this has been conspicuous particularly in cases where turn-key projects based on capital intensive technologies were handed over to the local owners. There have been cases where management contracts have been awarded to consulting organizations to help improve the efficiency and profitability of building materials plants in some African countries. 5/

20. Profound changes have occurred in the last years in the capital goods industry in developed countries. In most branches automation and robotization have revolutionized the production systems. The building materials industry has also been influenced by it. Fully automated plants have reduced the need for manual workers since their functions have increasingly been taken over by highly sophisticated machines and by technicians and engineers.

21. Countries wanting to enter or to expand the building materials industry are facing a situation where different technologies exist and have been tried in the developing world. Most building materials can be produced either in a semi-industrial manner or in mechanized or automated plants. What criteria should developing countries apply in the selection of technology and/or production capacity? So far, only a few developing countries have adopted explicit technological plans and strategies.

22. Currently, it is not possible to assert the absolute superiority of one technology over another. One technology can only be considered superior to another when the socio-economic conditions prevailing in the country in which it is to be applied at a given time are taken into account. This evaluation depends on a large number of factors such as the level of industrialization of the country, urban or rural demand, the available infrastructure (ports, roads, railways, etc.), the cost of distribution and the availability of

skilled manpower. Most enterprises, when confronted with the selection of equipment are limited in their choice by the lack of information and of indigenous consultancy services.

23. The need to strengthen the evaluating capacity for a better choice of technology can be exemplified by the case of the brick-making industry. In brickworks it is possible to combine equipment items of different technical levels. Entirely manual extraction and preparation processes can be combined with forming and firing processes using improved or mechanized presses, auger machines and non-continuous kilns. Techniques with a high labour content or improved or mechanized techniques for preparing, forming and drying the clay are in some cases more efficient than highly mechanized and automatic techniques. 6/ Adequate assistance would help entrepreneurs to avoid acquisition of unnecessary capital-intensive components.

24. Selection among available options is also very often hampered by the equity composition of joint-ventures and foreign enterprises. The source from which credit facilities may be available often determines the choice of a specific country. Another factor worth investigating relates to the conditions on technology options tied to loans by international lending agencies.

25. More often than not adequate information for the importing firm on alternative types of equipment is lacking. Moreover, the information is often one-sided. Most of it is focused on large-scale technologies, while information on small- and medium-scale technologies is virtually non-existent. The strengthening of information systems on alternative technologies for products like cement, bricks, lime, sand and cement breeze-blocks, emphasizing the small- and medium-scale units would permit many developing countries to make a better choice. Also, assistance to improve the evaluating capacity of different types of machinery would increase the ability of making adequate choices. Strengthening of industrial and information centres and the promotion of consultancy capabilities should be viewed as key factors in a better selection of technology for the country.

26. The conditions under which technology is acquired constitutes a continuous concern to developing countries. Decision-makers from government and the private sector are very often unaware of the possibilities to negotiate more

advantageous contracts for the acquisition of technology. To strengthen their negotiating capabilities different actions could be undertaken, like training courses, preparation of manuals, checklists for contractual arrangements, etc.

V. TRAINING

27. The type of training required has to be seen in connection with the level of complexity of the productive technology which is to be employed. For instance, in the case of cement production the automation of dry-process rotary kilns has forced a change in the structure of skills required as compared with those of older technologies: engineers and technicians represent nearly 40 per cent of the staff.

28. The training of skilled workers for new tasks and the training of technicians is receiving increasing attention from decision-makers in certain developing countries and in foreign companies that have carried out technology transfer operations.

29. In order to improve the performance of plants, a number of major firms from developed countries have concluded technical assistance contracts with developing countries, limited most of the time to improve individual know-how. However, the mere acquisition of individual know-how, although necessary, is not sufficient. In complex plants, know-how cannot be confined to single operations - no type of know-how can be expressed independently of other types. In fact, despite differences in content, manual workers, technicians and engineers have know-how that is interrelated - and mutually complementary in the manufacture of the finished product. Companies in industrialized countries must certainly transmit knowledge regarding the operation of machines, but also and above all their experience regarding the operation of plants as a whole. 7/

30. There is certainly great scope to increase co-operation between developed and developing countries in training in this sector. Developed countries, among other things, facilitate the access of students from developing countries to training institutions in developed countries and assist in the establishment and finance of training programmes, both in developed and developing countries. At the enterprise level, the development and improvement of long-term training arrangements in connection with transfer of technology seems to merit attention.

31. Some developing countries have already achieved considerable experience and expertise in training human resources in the building materials industry. This is the case in some Asian and Latin American countries and in the Maghreb countries. This experience could be usefully shared with other developing countries from the same region or subregion by means of the establishment of training institutions of regional character, which could provide technical and on-the-job training. Information about the training needs and training opportunities could be disseminated by the establishment of international information networks in order to increase communication among existing institutions and to promote co-operation.

VI. PRODUCTION AND ADAPTATION OF EQUIPMENT

32. In order to have a viable self-sustaining industry, it is necessary for the developing countries to gain a complete mastery of the production processes of building materials. It would be that much to their advantage if, in addition, they are able to master the knowledge of design and production of capital goods that manufacture the building materials. The creation of a national engineering capability which can meet these requirements has a number of advantages:

- It would permit the adaptation of equipment to local conditions;
- It would ensure expertise in the functioning of capital goods;
- It would provide for the manufacture of spare parts, thus reducing import dependence;
- It would make use of technological potential adapted to the levels of training of the work-force and management.

33. Engineering capability can also contribute to greater national self-sufficiency by tailoring technological choices to the adaptation and assimilation of capital goods. The training of engineers and senior technicians, and the establishment of research and development institutes, seem to be prerequisites for the acquisition of engineering capability at the national level.

34. Developing countries not capable of producing highly complex capital goods (e.g. cement works with long rotary kilns using the wet or dry process), could nevertheless establish the necessary conditions for the production of

single tools, capital goods of low technological complexity (mini-cement works for example) and spare parts. Expertise in the production of this type of plant would make it possible to progress gradually towards a mastery of production of increasingly complex equipment. Finally, a policy favouring the production of capital goods in the national territory would enable the developing countries to make a real "technological leap".

Points for discussion

35. The Consultation is invited to consider the following:

(i) What kind of measures could be adopted at the national, regional and international level in order to improve developing countries' research and development capability for building materials for which they have adequate raw materials? What is the scope for international co-operation to improve standards and quality control in developing countries? What measures could be undertaken to reformulate existing construction codes and regulations in developing countries in order to increase the use of indigenous building materials?

(ii) How can indigenous consultancy capabilities be promoted in developing countries, and industrial and information centres be strengthened to allow a better selection of technology? What is the scope of improving the negotiating capability of developing countries in the acquisition of technology, and what kind of measures could be undertaken to that end?

(iii) What is the scope for increased co-operation between developed and developing countries and among developing countries themselves in the field of training for building materials industries? What should be the role of international co-operation, both at the enterprise, government and the international organizations' level?

(iv) Could developing countries envisage the production of tools, spare parts and simple equipment? If so, what are the ways and means of international co-operation towards this end?

Notes

1/ UNIDO, Report of the First Consultation on the Wood and Wood Products Industry, ID/306, p.7. See also, Marcelo Tejada, Promoting the use of wood in construction, UNIDO, ID/WG.395/2, 1983.

2/ Gyula Sebestyén, Research priorities for the building materials industry in developing countries, UNIDO, ID/WG.425/1, 1984.

3/ ESCAP/UNIDO, The building materials industry in the ESCAP region, Division of Industry, Human Settlements and Technology of the Economic and Social Commission for Asia and the Pacific, Bangkok (mimeo), 1984, p.15.

4/ ibid., p.12.

5/ ECA, Needs, constraints and prospects of African countries regarding the availability of building materials (mimeo), 1983, p.5.

6/ Sid Boubekeur, Outline of a policy for mastering capital goods technology, UNIDO, ID/WG.425/4, 1984, p.50.

7/ ibid., p.35.